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OF THE
ROYAL COLLEGE OF SURGEONS OF ENGLAND

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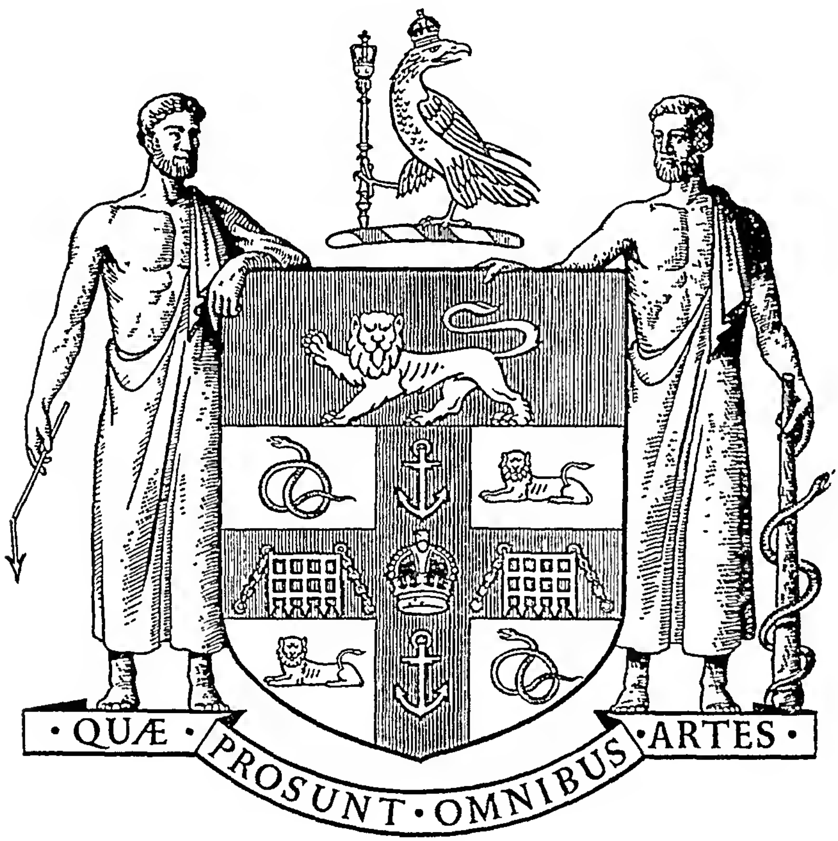

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FOREWORD

BY

THE PRESIDENT

SIR ALFRED WEBB-JOHNSON, BT., K.C.V.O., C.B.E., D.S.O., T.D.

" *Watchman, what of the night?*
The Watchman said, The morning cometh, and also the night: if ye will enquire, enquire ye: return, come."—ISAIAH XXI, v. 11 & 12.

THE fateful night of May 10th-11th 1941 saw the heaviest of the air attacks on London. It resulted in tremendous damage, but the casualties inflicted on the Luftwaffe and the demonstration that London "could take it," led to a cessation of mass attacks by piloted aircraft, which up to that date had occurred nightly without intermission for over eight months. On that dreadful night many national buildings were destroyed, including the House of Commons; and that same night saw the destruction of a large part of the unique Museum of the Royal College of Surgeons.

The damage to the Museum was a disaster of the first order for it was a loss to science. The collections were so enormous that it had been impossible to arrange for their evacuation to the country, but many specimens had been moved to the basement and were saved. Some, however, had been placed in a deep reinforced tunnel well below the basement level of one part of the building. Unfortunately, this stronghold proved as illusory a defence as the Maginot Line, for it was under a part of the Museum which was completely laid waste, and, as the fallen buildings accumulated, a great mass of brickwork, made white hot by raging fires, turned the "safe deposit" into a kiln of superlative heat, and the specimens were destroyed.

The College was the headquarters of a Section of the National Fire Service but, as luck would have it, the Brigades had been called away to deal with extensive fires elsewhere before the College was hit. It is however unlikely that the firemen would have been able to achieve much, as parts of the Museum were turned into a fiery furnace, and the alcohol in which many of the old specimens were preserved added fuel to the flames.

The first attack was with incendiary bombs, but, as the fire-watchers rushed to deal with these, high explosive bombs were dropped and a mighty holocaust resulted. Two of the Museum Halls were completely demolished. Another, which was a temple of pathology, was unroofed and the galleries destroyed. In this Hall was the National Memorial to John Hunter, which had been bricked in and covered with a thick roof of reinforced concrete. Over four years later, when the protective wall was removed, great was the relief to find that the statue had not suffered from the fires which had raged around it. The other two Museum Halls, which housed the anatomical specimens, were unroofed and the galleries damaged.

By kind permission of The Daily Mail.

ONE OF THE DEVASTATED MUSEUM HALLS.

By kind permission of The Times.

DAMAGE IN THE MAIN HALL OF THE COLLEGE.

The specimens which had been saved were evacuated to the country and as soon as possible temporary roofs were erected over the three halls, the walls of which were still standing.

From the front façade a passer-by might think that the College had suffered but little. Fortunately, the damage to the administrative departments and research laboratories, although serious, was not disabling, and essential College work could be carried on. One bomb however had dropped through the roof of the Council Room into the Main Hall. This part of the building was unroofed, the floor of the council room destroyed and the main hall and staircase thrown open to the heavens. In addition the flames had been fanned by the wind into the upper part of the main block, and three floors of research laboratories were gutted a temporary roof was built over the staircase and council room and the floor of that room and the ceiling of the hall were rebuilt.

The ceiling of the Library was rendered unsafe. Had not the books been moved to the country, owing to the foresight of Sir Hugh Lett, the damage from fire and water would have been disastrous. The library was originally designed by Barry—who built the Houses of Parliament—and was a perfect example of his best work. The ceiling was scheduled by " The Fine Arts Commission " as a work of art of national importance, and mouldings were taken of every detail. It was rebuilt exactly as it had been in design—but with a fortunate and unpremeditated result. The library is used for College dinners and other functions, and, before restoration, its acoustic properties were appalling. After rebuilding they were found to be perfect, the result presumably of different materials having been used in the reconstruction of the ceiling and the floor above.

Fortunately most of the essential temporary repairs were carried out before the V.1. bombs were launched on London. Had not the work been completed before this it would have been impossible to have had it done for some time, for the damage to buildings was terrific, and the needs of the people for houses in which to live or even exist were so urgent that all other building operations had to be abandoned.

Soon after V.E. Day the laboratories were rebuilt and the library and administrative parts of the College put into full commission. The specimens were rehoused in the temporarily restored Museum Halls and recataloguing was proceeded with as rapidly as possible. The College is now ready to receive the specimens which have been promised from all parts of the world to fill the gaps in the collections.

In planning for the future the Council have realised that their first duty is to restore the Museum, though not exactly as it was. The articulated skeletons of the larger mammals for example are now available for study at the Natural History Museum which did not exist in Hunter's time, while new developments in medical science demand places which were not provided before. But, in addition to this primary duty to restore the Museum, the Council realise that greatly increased space is needed for research and for the instruction of post-graduate students of surgery and the surgical

specialties. There is also an increasing demand for collegiate amenities such as common-rooms, dining and luncheon-rooms, and also for residential accommodation, particularly for graduates from the Dominions.

The Council have always been anxious to foster the closest possible relationships between the Royal College of Surgeons of England and the Sister Colleges in the Dominions. They therefore rejoice in the institution of a Commonwealth Travelling Professorship which will provide for prominent teachers of medicine and surgery to make tours of the Commonwealth and Empire in order to take part in research and post-graduate education.

This long-desired development has been made possible by a generous gift from "A New Zealand Family". The gift was anonymous in the first instance but the Council is now glad to have permission to disclose that the donor is Mr. Arthur Sims, a prominent New Zealand Industrialist, an ardent believer in the mission of the Commonwealth and Empire.

In order to restore the Museum and make adequate provision for *teaching and research, apart from providing residential quarters, the* Council have been advised that £250,000 will be required over and above what may be recovered from the War Damage Commission. Towards this sum nearly £180,000 has been subscribed. The King headed the list of donors and contributions have been received from Queen Mary, The Princess Royal and the King of Egypt. Grants of £80,000 from the Trustees of The Wellcome Foundation and £20,000 from the War Organisation of the British Red Cross Society & Order of St. John of Jerusalem have been received. Substantial help was given promptly by sister Colleges of Surgeons with a notable gift of over £10,000 from the Fellows of the American College. The medical profession as a whole showed their sympathy through the British Medical Association.

Besides this the evidence of the attachment and affection of the sister Surgical Colleges, the appeal launched in 1945 revealed the remarkable loyalty of the Fellows of the College where'er dispersed over the face of earth or water. Individual surgeons at home and in the Dominions and other countries, particularly Egypt, have subscribed most generously, and it has been an inspiring task to prepare plans for the future with so much loyal support. The help sent by surgeons living in the distant Dominions has been most striking, for they have but few opportunities of using the scientific facilities and social amenities which the College provides. Their support has convinced the Council that it is their duty to establish collegiate headquarters which surgeons and those aspiring to be surgeons can regard as their natural spiritual home.

Even with the present restricted space available efforts are being made to meet the requirements of post-graduate students. Besides arranging lectures and practical classes a Common-Room has been opened and luncheon is served in the College each day. Graduate students thus have opportunities of meeting socially the leading surgical teachers of the United Kingdom. College Dinners are held once a month, and graduate

students are eligible to attend. It is impossible to overrate what it may mean to graduates at home and from overseas to have such opportunities of meeting the leading teachers of the country. What a precious memory it would have been for the writer if as a young graduate he had been able to dine or lunch or even stay at the Royal College of Surgeons, and to have met the immortal Lister and others of the great men of his youthful days!

The Council have desired for some time that those practising special branches of surgery and the specialties allied to surgery should feel that the College provides for their academic requirements. Accommodation has therefore been provided for a Secretariat and meeting-rooms to serve the needs of the Faculties and Associations of various specialties, and representatives have been invited to attend the meetings of the Council. By Royal Charter authority has now been given to co-opt additional Members of the Council to be representative of branches of practice not represented on the Council by the ordinary process of election; to arrange for special Final Examinations for the Fellowship of the College for those desiring to practise Ophthalmology and Oto-laryngology; and to institute a higher diploma in Dental Surgery (F.D.S., R.C.S.). In addition powers have been granted to establish such Faculties in the College as may from time to time be thought fit.

A generous grant from the Bernhard Baron Trustees and the princely gifts of Sir William Collins enabled the Council to institute Professorships of Anatomy, Applied Physiology and Pathology. With these gifts and the great benefactions of the past from Sir Erasmus Wilson and Sir Buckston Browne, the endowment of the research departments has been built up to such an extent that the future scientific influence of the College is assured. Additional property has been acquired, and the College owns the freeholds of practically the whole of the South side of Lincoln's Inn Fields. Space is therefore available for the future development of the College of Surgeons and for other Colleges which may desire to occupy contiguous sites.

In answer to the appeal, letters were received from all parts of the world asking for regular information about the College, and about recent events and forthcoming programmes. The Council have therefore felt it a duty to publish a monthly journal which will be known as "The Annals of the Royal College of Surgeons of England." In "The Annals" will be published a selection of Lectures delivered at the College, and the publication will also include items of historical interest, accounts of recent events, and a diary of forthcoming functions, lectures and practical classes.

It is hoped that "The Annals" will keep Fellows and Members of the College throughout the world conversant with recent advances in Surgery, with ex cathedra statements on various surgical subjects, and with the affairs of the College. Suggestions for the improvement of "The Annals" will be welcomed by the Editorial Committee of which Sir Cecil Wakeley is Chairman.

THOMAS VICARY LECTURE

THE RENAISSANCE AND ITS INFLUENCE ON ENGLISH MEDICINE SURGERY AND PUBLIC HEALTH

By

Sir Arthur Salusbury MacNalty, K.C.B., M.D., F.R.C.P., F.R.C.S.

THOMAS VICARY, Serjeant-Surgeon to King Henry VIII, King Edward VI, Queen Mary and Queen Elizabeth, Master of the Barbers' Company, four times Master of the Barber-Surgeons' Company and Surgeon to St. Bartholomew's Hospital, flourished as England's leading surgeon from 1527 to 1562. His life was passed in stirring times. A new world had been discovered by Columbus. Vicary saw the convulsive change produced by the Reformation and the Dissolution of the Monasteries, the fires at Smithfield and Oxford smoking with the blood of the martyrs, and above all he experienced the influence of the Renaissance and the birth of freedom of thought, individual initiative and action which guided him in his work for British surgery.

It was in the times of Thomas Vicary, then, that a new spirit arose in national thought, and amid a despotic rule, much oppression and injustice, it is possible to trace advances in medicine and surgery, in public health, in social medicine and in culture and education.

It was not until the value of Greek thought became manifest to the practical Englishman that the influence of the Renaissance became widespread. This heritage was brought to England by a band of Oxford men known as the *Humanists*. The teaching of Colet, Grocyn and Linacre, together with young Thomas More, made Oxford famous as a seat of learning. Bishop Fox in 1516 founded Corpus Christi College at Oxford in the interests of the new learning, and John Fisher promoted the spread of Hellenic thought at Cambridge. Once the new learning was established in the Universities, it influenced national thought and practice.[1]

England in Tudor Times

The period of the Middle Ages, it has been remarked, had a child-like simplicity of outlook; it experienced extremes of joy and misery, everything was either black or white. It reverenced authority, that of the

Church in religion, of the aristocracy in politics, of Aristotle, Galen, Pliny and Pythagoras in science; it was inconsequent and thoughtless, and loved glitter and display. The England of Thomas Vicary's time was the nation's adolescence.[2]

Under Henry VII trade and manufactures, especially the woollen industry, were encouraged. The wealth of the country increased, but it was the wealth of a new and powerful class, that of the traders. Queen Anne Boleyn's grandfather was a London merchant, and the most powerful ministers employed by a Tudor king were Wolsey, the son of an Ipswich grazier, and Cromwell, the son of a Putney blacksmith. In the rural districts, the old villeinage or serfdom had gone. With the demand for wool, the landlords found it more profitable to convert their waste and tilled land into pasture land for sheep. In the words of Thomas More,[3] "they thrust husbandmen out of their own and made sheep consume, devour and destroy whole fields, houses and cities." This caused much discontent and unemployment, and partly explains the popular support which Henry VIII received in the dissolution of the monasteries which owned most of the land. The abolition of the craft guilds left guildsmen unemployed.

Thus the country in Tudor times was infested with destitute persons. Many became vagabonds, thieves and murderers. The Poor Law legislation of Henry VIII and Edward VI put the onus of relief on the charity of local districts. It was not until the celebrated Poor Law Act of 1601, which made the maintenance of the aged and invalid poor and the provision of work for the able bodied a statutory burden on the parishes through the levying of rates, that the problems of unemployment and destitution began to be handled effectively.

The extent of the population in Tudor times can only be broadly conjectured. A rough census was taken at the time of the Armada (1588), and was found to be something under five millions. The population, according to Froude,[4] had probably approached this figure many generations before. It had been a stationary population, and did no more than keep pace with the waste from disease, epidemics, high juvenile mortality and civil and foreign war. Wages and the prices of food were regulated, so far as regulation was possible, by Act of Parliament. Wages were high and food was cheap.

On the whole, except for the destitute and the very poor, the standard of nutrition was high. More people probably died of over-eating than under-nourishment, for the multitude of clerks, apprentices, retainers and labourers shared the good things of the tables of their masters.[5] The Spanish nobles who came into England with King Philip were astonished at the diet which they found among the poor. "These English," said one of them, "have their houses made of sticks and dirt, but they fare commonly so well as the king." "What comyn folke in all this world," says a State paper in 1515,[6] "may compare with the comyns of England

in riches, freedom, liberty, welfare and all prosperity? What comyn folke is so mighty, so strong in the felde, as the comyns of England?"

The success as rulers of Henry VIII and Elizabeth lay in the fact that their strength rested in the support of the common people and the middle classes. To this end wages and food prices were controlled, pageants were provided for their amusement, and contentment prevailed. The Renaissance introduced a new style of architecture and there was much building of houses or extensions to existing mansions. These dwellings were surrounded by parks and pleasant flower and herb gardens. The princes built palaces, such as Richmond, Nonesuch, Greenwich and Hatfield. Cardinal Wolsey's edifices at Hampton Court and Whitehall were both seized and completed by Henry VIII. The nobles, squires and wealthy merchants followed the royal example and new colleges were founded and built at Oxford and Cambridge. Dress, as we know from the portraits of Holbein, was ostentatious and costly among the courtiers and the well-to-do.

In various ways the amusement of all classes of society was catered for; there were theatrical performances, archery, athletic sports, pageants and shows, bull and bear baiting, badger drawing and cock fighting, while public executions, whipping at the cart's tail, ducking a scold and burning of witches and heretics, provided more sadistic excitement. Such was "Merrie England" in the time of Thomas Vicary.

Education

The Tudor monarchs encouraged and practised scholarship. Linacre was Prince Arthur's tutor. The Oxford humanists, as we have seen, had established the new learning in the Universities. Linacre founded medical lectures which bear his name at Oxford and Cambridge. Yet if it had not been for Sir Thomas Smith, "the flower in his time of the University of Cambridge," the Universities might have perished at the Reformation.

Thomas Vicary knew Latin, but was probably not a classical scholar. However, he emphasized the value of a good general education for the surgeon. He was to be reasonably well versed in philosophy, grammar and rhetoric and a "lettered" man. Vicary's knowledge of and affection for the works of Guido de Cauliaco is indicated by the request in his will "unto the hawle of my company one book called Guido." This was probably *Guido's Cyrurgia* of 1363.

At the grammar schools the boys were taught to read, write and speak Latin. At a few schools, like St. Paul's, Greek was taught and a little mathematics. The pupils were expected to know how to read and write before entrance, a fact which implies the existence of elementary schools kept chiefly by the clergy. Tyndale's translation of the Bible into English undoubtedly stimulated the spread of elementary education. On the whole, there was less illiteracy among the people of England in the sixteenth century than in the first half of the nineteenth. It may be assumed that the medical student in Tudor times received a reasonable

general education, particularly if he went to the University before entering on his professional studies.

Social Medicine and Public Health

In reviewing the general state of England in Tudor times, we have noted signs of progressive prosperity in trade and commerce, the abolition of serfdom and in the main a well-nourished and athletic population. When we turn to the consideration of social medicine and public health, the picture is much less favourable, but there are signs of gradual improvement.

It is in Henry VIII's reign that the beginnings of an enlightened public health policy in regard to water supplies can be noted, for in 1532 there was passed the important Act of Parliament (23rd Hen. VIII, C. 5) which appointed Commissioners of Sewers in all parts of the kingdom. Though much of the work of the Commissioners was riparian in character and directed towards preventing encroachments of the sea, flooding of low grounds and maintenance of river banks, regulations were also made against trade effluents, deposits of rubbish in rivers and pollution of rivers, streams and wells. The larger towns were provided with a regular water system with public standpipes, and water sometimes was laid on to the houses. London for a long time had been well supplied with water, but under the Tudors seven or eight more conduits were set up from which fresh water was hawked about the streets in barrels. These improvements in water supplies probably owed much to Sir Thomas More who was appointed one of the Commissioners of Sewers along Thames bank between East Greenwich and Lambeth in 1514.[7]

Epidemic Diseases

There was much disease in England in Thomas Vicary's days. "Surfeits" due to immoderate eating and drinking often occurred. Gout and stone prevailed among the well-to-do. Scurvy was prevalent, owing to the lack of green vegetables and vitamin-containing foodstuffs, until William Butler (1535-1618), a physician of Cambridge, put scurvy grass and other herbs into the beer. Scabies was so common that it was called "the English Itch." Syphilis was a deadly scourge, as Mr. Johnston Abraham[8] has shown, and Henry VIII was one of its victims. Leprosy (the term then also included several skin diseases) was nearly abolished through the rigid system of segregation in force, but apparently still lingered, for several leper hospitals survived up to and after the Reformation. Some quarter of a mile to the westward of Charing Cross there stood a religious foundation, a leper hospital with extensive lands, dedicated to St. James the Less, Bishop of Jerusalem. "It was founded," said Stow, "by the citizens of London before the time of man's memory, for fourteen sisters, maidens, that were lepers, living chastely and honestly in divine service." Henry VIII seized this in

1533, pulled down the hospital, " made a faire parke for his greater comoditie and pleasure " and built there " a goodly manor." Such was the origin of St. James's Park and Palace. There was much indigenous malaria, especially in the Fen districts.

Measles, smallpox and tuberculosis in those days took a heavy toll. Edward VI's racking cough and active consumption " were lit up by the attack of measles and smallpox from which he suffered in April, 1552."

Outbreaks of typhus fever appeared in Europe and began to be more frequent in the towns and overcrowded gaols of this country. In 1540, according to the Continuator of Fabyan's *Chronicle*, " divers and many honest persons died of the hot agues and of a great lask throughout the realm." The " hot agues " appear to have been typhus; the " lask " was dysentery. There were epidemics of influenza in 1510 and 1557-8 (Creighton).

But the deadliest epidemics of Tudor times were bubonic plague and the " sweating sickness."

Plague

Plague had remained endemic in England since 1349, the terrible year of the Black Death, which destroyed two million people, half the existing population. At the beginning of the sixteenth century there was a general recrudescence of the disease. After nearly depopulating China, it spread over Germany, Holland, Italy, Spain and Britain in the first decade of the century. In 1500 the plague was so severe in London that Henry VII retired to Calais. From 1511 to 1521 there is not a single year without some reference to the prevalence of plague in the letters of Erasmus and elsewhere. In 1518 plague infested London, and Henry VIII went to Abingdon where people, as he selfishly said, were not continually coming to tell him of deaths, as they did in London. In 1529 there was an outbreak at Edinburgh. From 1537 to 1539 there was much plague in London and in 1547-8 it is noted as rife in the North of England. The worst epidemic of the century was in 1563-4 when a thousand persons died weekly in London.

The chief protective measure was flight from the infected locality, the King and the Court setting the example. Sir Thomas More in a charge he made to the Mayor of Oxford in 1518, ordered inhabitants infected with the plague to keep in their houses and to " put out wisps and bear white rods." They were forbidden to keep animals in their houses, and officers were required to keep the streets of the town cleansed and burn refuse. This procedure was later enforced by the London plague bills of mortality in 1532, parish registers of deaths (1539), and the plague orders of 1543, which were adopted in the Elizabethan regulations. The white wand became the insignia of the " searchers " of infected houses (which had to be marked and closed) and the bearers of the dead. Additional orders later made by the Corporation of London prescribed

burning of infected clothing and bedding, cleansing of streets, closing infected houses for forty days and many regulations about scavenging and sanitation.

The Sweating Sickness

The sweating sickness was one of those mysterious maladies like influenza and *encephalitis lethargica* in our own time which suddenly make their appearance, wreak havoc and destruction for a while, and then as suddenly disappear.

Polydore Vergil[9] gives the following description of the malady:

> " In the same yere a newe kynde of sicknes came sodenly through the whole region euen after the first entryng of the kyng into this Isle whiche was so sore so peynfull, and sharp that the lyke was neuer harde of, to any mannes remembraunce before that tyme: For sodenly a dedly and burnying sweate inuaded their bodyes and vexed their bloud with a most ardent heat, infested the stomack and the head greuously: by the tormentyng and vexacion of which sicknes, men were so handled and so peynfully pangued that if they were layed in their bed, beyng not hable to suffre the importunate heat, they cast away the shetes and all the clothes liying on the bed. If they were in their apparell and vestures, they would put of all their garmentes euen to their shirtes. Others were so drye that they dranke the colde water to quenche their importune heate and insaciable thirst. Others that coulde or at the least woulde abyde the heate and stynche (for in dede the sweate had a great and a strong sauore) caused clothes to be layed vpon them as much as they coulde beare, to dryue oute the sweate if it might be. All in maner assone as the sweate took them, or within a short space after, yelded vp their ghost. So that of all them that sickened ther was not one amongst an hundreth that escaped: in somuche, that beside the great nombre which deceased within the cytie of London, two Mayres successiuely dyed of the same desease within viii daies and vi Aldermen. . . . At the length by study of the Phisicians . . . they learned a present and a spedy remedy . . . whiche is this: If a man on the daye tyme were plagued with the sweate, then he shoulde streyght lye downe with all his clothes and garmentes and lye styll the the whole xxiiij houres. If in the night he were taken, then he shoulde not ryse out of his bed for the space of xxiiij houres . . . and to absteyne from all meate if he might so long susteyne and suffre hungre and to take no more drynke neither hote nor colde, then wyll moderately quentche and delaye his thrustye appetyde."

Five epidemic outbreaks of sweating sickness occurred in England in the sixteenth century. The disease was first noted in August, 1485, a few days before the landing of Henry VII at Milford Haven. It spread to London, where it caused great mortality. In 1502 it seems to have been prevalent in the West Country, and Prince Arthur probably succumbed to it at Ludlow, when Katherine of Aragon was also attacked, but

recovered. In 1507 a milder outbreak occurred, but 1517 saw a third and much more severe epidemic. It ravaged Oxford and Cambridge and other towns, half the population perishing in some cases. It was confined to England except that it spread to Calais and Antwerp. The fourth epidemic in 1528 was one of great severity. Appearing first in London, it soon spread over the whole of England. Scotland and Ireland were not affected. In London that summer the mortality was very great. " One has a little pain," wrote Du Bellay,[10] the French ambassador, " in the head and heart. Suddenly a sweat breaks out, and a physician is useless, for whether you wrap yourself up much or little, in four hours, sometimes in two or three, you are despatched without languishing."

The disease terrified Henry VIII, who fled from Greenwich to Eltham and thence to remoter places. Archbishop Warham went on with his duties, but eighteen members of his household died, and at Hampton Court where Wolsey displayed equal courage in sticking to his post, his suite was decimated. The Duke of Norfolk was stricken, but recovered, and Cary, Poyntz and Compton, three of the King's courtiers, died. Henry kept a physician constantly with him, confessed his sins daily and occupied his time with prayers and experiments in nostrums against the sweat. The disease spread to the Continent and caused a fearful mortality in Eastern Europe, extending as far as Poland, Russia and Scandinavia. In Hamburg several thousand persons died in a few weeks. France, Italy and the southern countries of Europe escaped. The malady usually lasted a fortnight in each place. By the end of the year " the terrible English Sweat," as it was termed, had entirely disappeared except in eastern Switzerland where it lingered on into the next year. The fifth and final epidemic was in 1551 and was well described by Dr. John Caius in a treatise entitled: *A Boke or Conseil against the Disease Commonly called the Sweate or Sweating Sickness* (1552).* It did not cause much fatality among the poor, but chiefly affected the rich and those who were free livers. Caius noted that " they who had this sweat were either men of wealth, ease or welfare, or of the poorer sort such as were idle persons, good ale drinkers and tavern haunters." Dr. Creighton,[11] the epidemiologist, and Dr. Michael Foster[12] considered that the only disease of modern times which bears any resemblance to sweating sickness is *miliary fever* (schweiss-friesel, suette miliaire or " the Picardy sweat "), a malady repeatedly observed in France, Italy and South Germany, but not in the United Kingdom. It was characterized by intense sweating and an eruption of vesicles, lasted longer than sweating sickness, occurred in limited epidemics and was usually not fatal. The first epidemic was

* I am indebted to Professor W. G. Hoskins for a reference in Nichol's *History of Leicestershire* (p. 891), wherein is given an extract from the Loughborough Parish Register for 1551, as follows: 1551, June: " The Swat, called New Acquaintance, alias Stoupe Knave and Know thy Master began 24th of this month." The Register then mentions twelve persons who were buried in twelve days, and then goes forward to another page where it is written at the top, " The Sweat or New Acquaintance," and mentions seven names all buried in three days, in all nineteen in six (sic) days. After this it seems to cease.

seen in 1718; it continued to 1906 and even later. There were 175 epidemics in France alone.

The physician in Tudor times could do little to check these prevalent epidemics. It was not for want of trying. He exhibited numerous drugs and preparations for the plague and sweating sickness, many of which were unpleasant and based on folklore. Dr. Butts, Dr. Chambre, Dr. Cromer and Dr. Augustin de Augustinis drew up a MS. Pharmacopœia of plasters (spasmadraps) and unguents, principally for the use of Henry VIII (Sloane MSS. British Museum, No. 1047). The method of their preparation is very complicated, and they contain, amongst a few efficacious articles, many which are useless.

It has been shown, however, that public health administration on an organized and permanent basis, as denoted by the protection of water supplies, scavenging and plague regulations, had its beginnings in this age. Here again we see the influence of the Renaissance which for the first time applied reason and intelligence to the prevention of disease. Let us for a moment consider the enlightened views of three men in this connexion.

Three Tudor Pioneers in Public Health

Sir Thomas More (1478-1535) is well known as Speaker of the House of Commons, Lord Chancellor, eminent humanist, saint and martyr. In addition, he was a great health reformer. We have to wait until the nineteenth century for a man of equal vision and breadth of view to appear in Edwin Chadwick.

More's friendship with Linacre probably first turned his attention to the problems of public health. His work as Commissioner of Sewers and in controlling plague has already been described. His unfinished treatise, *De Quatuor Novissimis*, written in 1522, a religious book, is full of medical lore and preventive medicine on which he draws for comparison. He believed in treacle as a safeguard against contagion. " Now if a man be so dainty-stomached that going where contagion is, he would grudge to take a little treacle, yet were he very nicely wanton if he might not at the leastwise take a little vinegar and rose-water in his handkerchief." In *Utopia*, printed at Louvain in 1516, More gave an account of " Nowhere "—the imaginary Commonwealth of the Renaissance idealists. The citizens of Utopia esteemed health as " the greatest of all pleasures." Inspired by his knowledge of the principles of Greek medicine, More[3] applied his learning to a description of desirable public health provision in Utopia.

He envisaged a well-built city with gardens and open spaces, a public water supply, drainage and cleansed streets, with public abattoirs outside. Public hospitals were provided for the treatment of rich and poor and isolation hospitals for cases of infectious disease. Other amenities included communal meals, the safeguarding of maternity with municipal nurses for infant welfare, nursery schools (or crèches) for children under

five, free universal education for all children with continuation, adolescent and adult schools; religious instruction, industrial welfare, enlightened marriage laws and eugenic mating and obedience to the laws of health, including fresh air and sunlight and active occupation without undue fatigue.

It is a comprehensive programme of social medicine, which, written in the sixteenth century, expresses many of the aspirations of to-day. If Sir Thomas More had had a wise and discerning master, if that master had given him due authority and powers in administration, England would not have had to wait three hundred years for the initiation of national public health. Instead, Henry VIII sent Sir Thomas More to the scaffold.

Sir Thomas Elyot (? 1490-1546), diplomatist and author, was also an enlightened social reformer. He was traditionally an M.D. of Oxford, although no evidence of this is extant.[13] He was English ambassador to the Court of the Emperor Charles V, served on several foreign missions and was knighted by Henry VIII, being the first medical man (according to Dr. S. D. Clippindale) to be thus honoured. He wrote *The Castel of Health* (London, 1534), a Latin-English Dictionary (1538) and *The Boke named the Governor* (1531), a treatise on the education of statesmen. *The Castel of Health* is a medical treatise of prescriptions for various ailments, and Elyot gives an account of the disorders from which he himself suffered. He noted that children after their first infancy suffer from a number of maladies and in " England commonly purpyls, meazels and smallpockes." This is the first use of the terms in a systematic work on medicine. The book, like Elyot's other book, was written in English and this aroused resentment among the physicians who regarded Elyot as a layman; he was, at all events, not a practising physician. Elyot replied to his critics in a preface to the edition of 1541 and mentions that before he was twenty he read with " a worshipful physician " (probably Linacre) the works of Galen and other medical writers. The treatise was very popular; its teaching is fundamentally unsound, for it is based upon the Galenic doctrine of the " four humours," which then dictated diagnosis and treatment. Elyot also believed in astrology, for he writes: " The causes whereby the air is corrupted be specially four: Influence of the sundry stars, stagnant waters, carrion, overcrowding." The merits of the book are its description of diseases and its independent clinical observations.

Almost contemporary with *The Castel of Health* was the *Book of Children*, by Thomas Phaer or Phayre, in which he gives a list of forty infirmities of children, including a description of " smallpockes and measels." The two diseases were almost regarded as one and were frequently confounded. Thomas Phaer was more of a literary compiler than a physician with original knowledge of diseases. In 1547 he published a *Treatise of the Pestilence*, which was largely copied from a fourteenth-century book on the plague by the Danish bishop of Aarhus.

The third Tudor pioneer in public health was Dr. Andrew Boorde or Borde (? 1490-1549), traveller-physician, " Andreas Perforatus " as he humorously styles himself. He was originally a Carthusian monk, but not being able to abide the rigours of the fraternity (vegetarianism and fasting), he travelled extensively over the continent of Europe " to have the notycyon and practes of Physycke in diuers regyons and countres." In his longest tour (*circa* 1537) he went as far afield as Jerusalem in order to see the Holy Sepulchre. His patrons were Sir Robert Drewry, the Duke of Norfolk, whom he attended and cured, and Thomas Cromwell. Norfolk presented Boorde to Henry VIII. He was an inveterate nomad and practised for a year in Glasgow. He wrote to Cromwell in 1536: " I am now in Skotland in a lytle vnyuersyte or study named Glasco where I study and practyce physk . . . for the sustentacyon of my lyüyng." After practising successfully in London, he settled at Winchester. There he was involved in a scandal and later was put in the Fleet prison in London, where he died in April, 1549. Boorde had a special affection for Montpellier, where he resided for some length of time. He describes it as " the most nobilis vniuersite of the world for physicions and surgions " and " the hed vniuersite in all Europe for the practes of physcke."

It was at Montpellier that he wrote his *Fyrst Boke of the Introduction of Knowledge*, published 1547 (?) ; the first printed Handbook of Europe ; his *Dyetary*, published in 1542 (?) ; his *Breuyary of Health*, published in 1547 ; and his lost *Boke of Berdes* (beards) condemning them. Boorde's *Dyetary* is an excellent manual of hygiene based on his medical experience and full of sound commonsense. On nutrition he gives good advice :

> " Two meales a daye is suffycyent for a resting man ; and a labourer may eate three tymes a daye ; and he that doth eate ofter, lyveth a beestly lyfe . . . Also sondry meates eaten at one meale is not laudable ; nor it is not good to syt long at dyner and supper. An houre is suffycyent to syt at dinner ; and not so longe at supper."

He also points out the unwise custom of beginning with heavy meats and only putting on better, light and nutritive meats when the appetite is assuaged. The prodigious feasts of the time show that little heed was paid to his counsels.

The instructions in the book for choosing a site and for the building and hygiene of a country house, could hardly be bettered by the textbooks of to-day. These three men—More, Elyot and Boorde—were far ahead of their age. Under the rising sun of the Renaissance they grasped the fundamental principles of social medicine, nutrition and education, and set forth their application in their writings. Much of the seed lay dormant for centuries. It is only in the public health and social reform of to-day that we begin to reap the harvest of their work.

The Hospitals

One of the most evil results of the dissolution of the monasteries was the abolition of the hospitals maintained by the monks for the care and

Sir Thomas More in his fiftieth year, by Hans Holbein (Rôyal Library, Windsor Castle). By gracious permission of His Majesty The King.

HENRY VIII GRANTING THE ACT OF UNION TO THE BARBERS AND SURGEONS, BY HANS HOLBEIN.

By kind permission of The Barbers' Company.

T. VYCARY.

Surgeon to H^r VIII

treatment of the sick poor. In this short-sighted policy Henry VIII was probably influenced by a scurrilous pamphlet called the *Supplication of the Beggars*, by one Simon Fish, a lawyer of Gray's Inn and a friend of Tyndale's.[14] It was sent to Anne Boleyn, who gave it to the King. It advocated and recommended the wholesale confiscation of Church property and endowments, and that, as the writer pretended, for the benefit of the poor. The double-faced Henry referred the pamphlet to Sir Thomas More, who in 1529 published a counterblast to it, entitled a *Supplication of Souls*. The wise humanist exposed the folly of doing away with the hospitals in these words:

> " Then cometh he at last unto the device of some remedy for the poor beggars. Wherein he would have none hospitals made, because he saith that therein the profit goeth to the priests. What remedy findeth the proctor for them? He will allow them no hospitals."

Henry ignored More's advice. By 1539 the total number of suppressed religious establishments was 655 monasteries, 90 colleges, 2,374 chantries and free chapels, and 110 hospitals.

In London the five priories of Austin Canons: Holy Trinity or Christ Church, just within Aldgate, St. Bartholomew's in West Smithfield, St. Mary Overies, St. Mary Spital and St. Mary's Elsing Spital had maintained hospitals for the sick and infirm. They were St. Mary Spital, St. Mary's Elsing Spital, St. Bartholomew's and St. Thomas's in Southwark, St. Mary of Bethlehem (Bethlem Bedlam) for insane patients, was outside Bishopsgate on the site now occupied by Liverpool Street Station.[15]

The Corporation of London foresaw the evil that would result from the abolition of these hospitals and, in 1538, Sir Richard Gresham, the Lord Mayor, wrote to the King on behalf of " the poor, sick, blind, aged and impotent persons . . . lying in the street, offending every clean person passing by with their filthy and nasty savours." He asked that the three remaining hospitals, St. Mary Spital, St. Bartholomew's and St. Thomas's, and also the Abbey of Tower Hill, might be placed with their revenues at the disposal of the Mayor and aldermen, so that " all impotent persons not able to labour might be relieved." Nothing was done, but the Court of Aldermen pursued the matter. After the dissolution, they represented " the great infection and other inconveniences " which had followed the closing of the friars' churches. It was not until the outbreak of wars with Scotland and France that Henry took notice of the appeal, because he wanted money and credit from the City. In 1544 he refounded St. Bartholomew's Hospital, but afterwards resumed possession of it. Henry's physicians said the only way of getting the King to listen to reason was to have him fall ill. This was exemplified on his death-bed in 1547, when he made the comprehensive agreement with the citizens which led to his posthumous, if unmerited, distinction as first founder of the " Royal Hospitals." The citizens obtained all they asked, and were also made governors of Bethlehem Hospital with all its posses-

sions. A sum equal to the estimated value of the endowments of the hospitals' 500 marks a year, was to be raised in London annually; provision was to be made for the cure of souls, and all the remaining revenues were to be devoted to the relief of the poor.

Early in the reign of Edward VI, some money was collected and St. Bartholomew's was reopened, doubtless much to the joy of Thomas Vicary; in 1552 Edward added St. Thomas's Hospital and its rectory to his father's gift, and the citizens bought other property from him, the transaction being ratified by Act of Parliament. The Corporation then raised large sums and formulated an elaborate scheme for the treatment of the sick and the relief of poverty. Poor house-holders received outdoor relief; the sick were tended at St. Bartholomew's; the permanently infirm at St. Thomas's; the children of poor persons were fed, clothed and educated at Christ's Hospital (founded in the buildings of the Grey Friars); the insane were treated at Bethlehem Hospital; the undeserving, vagabonds and worse, were made to work in Bridewell, which was of the nature of a prison hospital. Bridewell had been one of Henry VIII's palaces; after 1531 it was used as a residence for ambassadors; Edward VI, when dying, gave it to the City, but it was not until 1556 that Queen Mary reluctantly relinquished it.

In this way, through the wisdom and persistence of the merchants and citizens of London, the five Royal Hospitals were founded. This enlightened policy checked disease, aided London's health and medical education, and is one more example of how the teaching of the Renaissance promoted social reform.

The blow struck at the treatment of the sick in the provinces by the suppression of the hospitals was more deadly. A few of the old hospitals were refounded, but twenty-three of the principal English counties had no hospital until the eighteenth century.

Revival of Medicine

In the Middle Ages the physicians were chiefly ecclesiastics. But there were, as the preamble of the Act of the third year of King Henry VIII recites, a great number of ignorant persons exercising "the science and cunning of physic and surgery, to the perfect knowledge whereof be requisite both great learning and ripe experience." These were unlettered persons, common artificers, as smiths, weavers and women, some being unable to read and yet professing to treat and cure disease. This Act provided that no one shall practise medicine within the City of London or within seven miles of it unless he have been examined, approved and admitted by the Bishop of London or the Dean of St. Paul's. In medicine the candidates were to be examined by four doctors of physic; for surgery, other expert persons in that faculty. Outside London and its precincts the examinations were to be by the Bishop of the diocese, or his vicar-general, with such expert persons as he may think convenient. The Act did not apply to Oxford and Cambridge medical graduates.

This reform, the first beginning of organization of the medical profession in England, was undoubtedly due to the influence of Henry's physician, Thomas Linacre, a medical graduate of Padua and Oxford, who had seen the reputation and distinction to which the medical profession could attain in Italy under the star of the Renaissance, and in the interests of the public wished to separate physicians and surgeons from the horde of empirics and quacks. As is well known, he followed up this first essay by founding the Royal College of Physicians of London in 1518. The Letters Patent state that to the establishment of this incorporation the King was moved by the example of similar institutions in Italy and elsewhere, by the solicitations of at least one of his own physicians, Thomas Linacre, and by the advice and recommendation of his chancellor, Cardinal Wolsey. The Letters Patent were confirmed by Statute 14, Henry VIII. The original founders of the College, John Chambre, Thomas Linacre, Ferdinand de Victoria, all physicians to the King, Nicholas Halsewell, John Francis and Robert Yaxley, with the addition of two other physicians, Richard Bartlot and Thomas Bentley, were named Elects, who should yearly appoint from among themselves a President. No person, except a graduate of Oxford or Cambridge, without dispensation, was to be permitted to practise physic throughout England unless he had been examined and approved by the President and three of the Elects.

> "It was expedient and necessary to provide that no person be suffered to exercise and practise physic, but only those persons that be profound, sad and discreet, groundedly learned and deeply studied in physic."

The apothecaries were then members of the Grocers' Company, by whom they were regulated. All apothecaries had their wares and medicaments examined by four representatives of the College of Physicians.

As indicative of the influence of the Renaissance in medicine, it is to be noted that three at least of the founders possessed foreign medical degrees. John Chambre, a priest, was M.D. of Padua and Warden of Merton College, Oxford; Thomas Linacre, who took orders late in life, was M.D. of Padua, and Ferdinand de Victoria, who was also physician to Queen Katherine of Aragon, had probably a Spanish medical degree. Six of the eight Elects, if not all, were Doctors of Medicine of Oxford, so that this University had the major share in founding the College.

Oxford in Tudor times had a prescribed medical course. The M.D. could not be got in less than fourteen years. The Statutes demanded the initial Arts course to the M.A. degree then a faculty course of seven years. The student had to dispute twice, respond once, and see two anatomies before obtaining his Bachelor's degree. A dispensation might be obtained allowing the medical faculty course to begin at the B.A. stage; this shortened the course to the M.B. stage by about two years, and enabled the student to get the licence to practise and the licence to give "cursory" lectures to his juniors. He then became a pupil teacher or demonstrator. The full course still demanded fourteen years from

matriculation. The candidate must perform two anatomies and effect at least three cures before he was admitted to the M.D. (K.Ed.VI Statutes, 1549). Provision for clinical study both in physic and chirurgery was woefully deficient. To obtain this the best students went to Continental schools or gained experience as Army medical officers.

King Edward VI sent a Special Commission to Oxford to see how medical education could be improved, with power, if necessary, to assign one College solely to the study of medicine. This Commission effected little, for shortly afterwards, in Queen Mary's reign, the College of Physicians protested to Cardinal Pole against the admission of ignorant and unlettered men to medical degrees. The fact was that this licensing of physicians and surgeons produced a dearth of medical practitioners. To remedy this, alien practitioners had to be imported, examined and licensed to practise. The standard of practice after being partly—though far from entirely—redeemed from the quacks, was lowered again by the dissolution of the monasteries, when many ejected priests turned to medicine for their livelihood. Thomas Powel quotes the words of one of these priests, who proposed—unwillingly—to do this:

> "I have no other means left for my maintenance but to turn physitian, and before I shall be absolute master of that mystery, God he knowes how many men's lives it will cost. For few physitians use to try experiments on their own bodies." (*Art of Thriving*, by Thomas Powel. Scott's Somers' Tracts, 7,200.)

Several papers have been written by Dr. Goldwin Smith,[16] and others with the object of emphasizing the low standard of medical practice in these times. Dr. Edgar[17] and Dr. Pomeranz[18] have pointed out, with apt quotations, what a poor figure the physician cuts in the plays of Shakespeare and in those of other Tudor dramatists. But the doctor has always been the theme of satire on the stage from the comedies of Plautus and Terence to *The Doctor's Dilemma.* It has also been remarked that the physicians of the Tudor Age made few contributions to the advancement of medical knowledge. Such a stricture is too severe, when the writings of John Caius on the sweating sickness and those of Sir Thomas Elyot and Andrew Boorde are remembered. Queen Elizabeth termed Caius " the most learned physician of his age," an epithet which posterity has confirmed. Caius was a physician, an anatomist, a great classical scholar, an antiquarian and a naturalist. Then there were Edward Wotton (1492-1555), M.D. of Padua and Oxford, the first English physician to publish a systematic treatise on natural history, and William Turner (d. 1568), M.A. Cambridge, and M.D. of Bologna or Ferrara, and Dean of Wells, the first Englishman who studied plants scientifically. His *Herval* marks him as the father of English botany. The Elects of the College of Physicians, Sir William Butts, who interceded with his royal patient, Henry VIII, both for Wolsey and for Cranmer, and others, were regarded by their contemporaries as eminent physicians. In their busy professional lives they had little leisure for setting down the fruits of their

experience, and what advances they made in the healing art went unrecorded. I must refer here to one illustrious Tudor physician, perhaps the most lovable of them all.

John Clement, M.D. Oxon, was brought up in the household of Sir Thomas More, who said of him : " He is so proficient in Latin and Greek that I have great hopes of his becoming an ornament to his country and to literature." That aspiration was fulfilled. In 1519 Clement settled in Corpus Christi College, Oxford, having been appointed Wolsey's rhetoric reader in the University and later professor of Greek. More wrote to Erasmus :

> " My Clement lectures at Oxford to an audience larger than has ever gathered to any other lecturer. It is astonishing how universal is the approbation and love he gains. Even those to whom classical literature was almost anathema attend his lectures and gradually modify their opposition. Linacre, who, as you know, never praises any one very much, admires him greatly, so that if I did not love Clement so much I should be almost tempted to envy the praise he wins."[19]

Clement's wife, and former pupil, Margaret Gigs, was deeply read both in Greek and medicine, and helped him in his work. He became F.R.C.P. in 1528, and in the following year was one of the physicians sent by Henry VIII to Wolsey when he lay ill at Esher after his fall from favour. In 1544 Clement was elected President of the College of Physicians. Constant like More in his attachment to the old faith, Clement retired to Louvain when Edward VI ascended the throne. He returned to England in Mary's reign, but the accession of Elizabeth drove him once more abroad. He died at Mechlin in 1572. His writings relate to classical studies, and he does not seem to have given the world the benefit of his medical knowledge.

The dividing line between physician and surgeon was not clearly drawn under the Tudors. By the Physicians' Act of 1540 (32 Hen. VIII) medicine was defined as comprehending surgery and gave the physicians the right to practise surgery when and where they liked. Some of the surgeons practised physic, although this was forbidden by an Act of 1543 which stated : " No common surgeons may administer medicine outward . . . for although the most parte of the said craft of surgeons have small coonning, yet they woold take great soomes of money and doo little therefore ; and by reason thereof they doo oftentymes impaire and hurt theyre patients, rather then do them goode."

Caius, as we know, lectured on anatomy, and the Barber-Surgeons enlisted the services of good physicians to teach their members both anatomy and surgery. One of these was Richard Caldwell, M.D.Oxon, F.R.C.P., who, with Lord Lumley, founded a surgery lecture, the Lumleian Lectures. The Barber-Surgeons' Company, to whom this was first offered, failed to take advantage of it, and the lectureship then went to the Royal College of Physicians.

Other physicians practised obstetrics as well as physic. George Owen (d. 1558), M.D.Oxon, physician to Henry VIII, Edward VI and Mary, is said to have brought Edward VI into the world by performing Caesarean Section on his mother. Owen was President of the College of Physicians in 1553 and 1554, and was the author of a treatise entitled " A Meet diet for the New Ague set forth by Mr. Owen," Fol. Lond. 1558.

We must be mindful that the Tudor Age was one of transition. As Sir John Simon [20] has observed :

> " Apothecary, surgeon, physician, each had a mark of his own: the first, his familiarity with the uses of worts and drugs ; the second, his skill for bleeding, bandaging, bone-setting and the like ; the third his book-learning, especially in the Greeks and Latins, and often his mastery of at least one occult science : but the apothecary was still a variety of grocer, the surgeon still a variety of barber, and the physician but just ceasing to be an ecclesiastic."

Under the influence of the Renaissance, Thomas Linacre organized physicians into a fraternity, promoted their education on the lines of Greek thought, and established English medicine as a scholarly and learned profession. He received much help from his illustrious medical contemporaries and immediate successors. The value of this achievement must be measured by its after-fruits rather than by its immediate results in the advance of medical knowledge, though these were by no means inconsiderable.

Revival of Surgery

Many physicians, as we have noted, were still ecclesiastics. So at first had been many of the medieval surgeons, particularly among the Benedictines, until the practice of surgery by the clergy was forbidden by the Council of Tours in 1163.

In 1279 a College of Surgeons, under the patronage of St. Cosmes and St. Damianus, known as the Collége de St. Côme, was founded by Pitard, who had accompanied St. Louis to Palestine as his surgeon. It attracted many pupils, and the corporations of surgeons in London and Edinburgh were modelled upon it.

But medieval surgery was based largely upon tradition, surgical writings were reproductions of the classical or Arabian authors, and it was not until the Renaissance that surgeons dared to employ independent observation and reflection.

Sir Hugh Lett,[21] in a previous lecture, has shown how the study of anatomy was revived and freed from stereotyped beliefs by Andreas Vesalius (1514-1564) of Padua, how anatomy was studied and encouraged at Barber-Surgeons' Hall, and the contribution that Thomas Vicary made to this foundation of true surgery in his administration and teaching, and by his elementary textbook for apprentice-students entitled *A Profitable Treatise of the Anatomie of Man's Body*, which, unfortunately, was based upon the old treatises of Galen and others, and did not include the new teaching of Vesalius.

Vesalius's great work on anatomy was published at Basle in 1543, and as early as 1545 Thomas Gemini brought out a translation of Vesalius's *Epitome* entitled *Compendiosa totius Anatomie delineatio*, with copper-plate engravings copied from Van Calcar's woodcuts. It was dedicated to Henry VIII. In 1553 Gemini published an English translation of his Compendium made by Nicholas Udall, better known as the author of the first English comedy, *Ralph Roister Doister*. This manual was dedicated to Edward VI. The third edition in 1559 was dedicated to Queen Elizabeth.

There was also a new spirit abroad in surgery, which was first kindled on the Continent by P. Paracelsus (1493-1541) and by Ambroise Paré (1510-1590). Paracelsus was notable as a direct observer of disease processes, for example hospital gangrene and healing of wounds. His special surgical treatises are *Die Kleine Chirurgie* (1528) and *Die Grosse Wund-Arznei* (1536-1537). Paré's treatment of gunshot wounds by simple dressings instead of hot oil, and his use of the ligature for large arteries, thus rendering amputation possible on a more extensive scale, are well known.

Thomas Vicary's work in uniting the Corporation of Surgeons with the Barber-Surgeons, and in promoting the teaching of anatomy and surgery, led immediately to progress in British Surgery.

First, as students were well taught by experienced surgeons, operative surgery became much more dexterous and resourceful. This led on to further advances. In lithotomy, improvements were made in the use of the staff and other instruments. A " radical " cure of hernia superseded the application of the actual cautery, operation for stricture of the urethra was improved, plastic operations were done, and ophthalmic surgery was taken to some extent out of the hands of quacks. Trephining was largely practised, even for persistent migraine. Philip William, Prince of Orange, is said to have been trephined seventeen times.

One of the duties of a royal surgeon was to attend on the torture or maiming of a State prisoner who had been sentenced to such an ordeal. In the former case he had to see that the punishment was not prolonged to the danger of the victim's life ; in the latter he had to check haemorrhage and dress the mutilated stump. Probably Thomas Vicary attended when Sir Edmund Knyvet was adjudged to lose his right hand for striking the Master Clare of Norfolk, a servant of the Earl of Surrey, in the royal palace. It was a dread and solemn ceremony.

> " The Sergeant Chirurgeon came with his instruments ; the Sergeant of the Woodyard with mallet and block where the hand was to lie ; the King's Master Cook with the knife ; the Sergeant of the Larder to set the knife right on the joint ; the Sergeant Farrier with searing irons to sear the blood-vessels ; the Sergeant of the poultry with a cock to be killed on the same block with the same knife ; the Yeoman of the

Chandry with sear cloths; the Yeoman of the Scullery with a pan of fire to heat the irons; a chafer of water to cool the irons, and two forms for the officers to set their stuff on; the Sergeant of the Cellar with wine, ale and beer; and, lastly, the Yeoman of the Ewrie with a basin, ewer and towels."

As Sir Edmund laid his hand on the block, word was brought of the King's pardon. Kind-hearted Katherine Howard had pleaded with Henry VIII for remission of the punishment.[22]

We may justifiably assume that the rejuvenating spirit of the Renaissance inspired many of Thomas Vicary's surgical contemporaries and successors. There was John Halle of Maidstone, no doubt a friend of Vicary, who on the instructions of the Barber-Surgeons' Company evicted quacks from that district by searching medical examinations. He wrote a book called *Historiall Expostulation against the Beastlie Abusers of Chirurgery and Physick in our Time.*

Thomas Gale (1507-1587), apprenticed to Richard Ferris, a distinguished Barber-Surgeon, at first served as an army surgeon with Henry VIII's troops at Montreuil. He removed the unqualified practitioners, who were decimating the English regiments, from the Service. Later he settled in London, and in 1561 became Master of the Barber-Surgeons. Two years later he published his *Certaine Works of Chirurgerie.* He advocated conservative surgery and attacked the envenomed theory of gunshot wounds. The " sure grounds " on which surgery was to be founded were that the student should be " lettered," " expert," " ingenious," " vertuous " and " well-maneryd." Treatment was not to be done solely for " lucre or gayne's sake," though this did not exclude " an honest and competent rewarde."

Thomas Gale succeeded Thomas Vicary as lecturer at Barber-Surgeons' Hall, and was in his turn succeeded by William Clowes. The latter was Surgeon to Queen Elizabeth and on the staff of St. Bartholomew's Hospital. Born about 1540, he served first as an army surgeon in the Earl of Warwick's army at Le Havre, and later as a naval surgeon in the victory over the Armada. He first wrote on *De Morbo Gallico* (1579). In spite of its Latin title, it was written in English. He also wrote on tuberculous affections of the skin, affirming the efficacy of the royal touch for cases not responding to ordinary treatment. He recorded his long experience and many interesting cases in his *Prooved Practice for all Young Chirurgians.* Clowes was rough of speech and free with his hands. In 1577 he was hauled up before the Court of Barber-Surgeons for fighting in the fields with George Baker, another royal surgeon, and was pardoned.

The Company of Barber-Surgeons undoubtedly raised the study and practice of surgery to a high level, organized professional teaching and standards, raised the social status and general education of the surgeon, and opened a new era in observation and treatment of surgical maladies.

Here the highest meed of praise is due to Thomas Vicary and his followers, Thomas Gale and William Clowes.

CONCLUSION

For an hour we have gone back together to the England of the sixteenth century and have tried to realize the times in which Thomas Vicary lived. We have seen his royal patients, bluff King Hal, the consumptive boy King Edward, the sallow-faced tragic Queen Mary and the red-haired, be-ruffed, resplendent Queen Elizabeth, with " the body of a weak, feeble woman ; but having the heart and stomack of a king—and of a King of England, too." We have met in Thomas Vicary's company the men he knew and who influenced him, the scholarly Linacre, the learned Erasmus, Dean Colet, Sir Thomas More, the saint and martyr, Sir Thomas Eylot and facetious Andrew Boorde, Sir William Butts and other Tudor physicians ; and the surgeons, Thomas Gale and William Clowes ; all like Vicary inspired by the Renaissance and who laboured together to improve education, medicine, surgery and public health so as to leave their country a better place than they found it.

At Vicary's side, in imagination, we have trudged through the ill-paved streets under the overhanging gables of the houses. We have witnessed the ravages wrought by the plague and the sweating sickness. We have gone into the country, visited the pleasant manor-houses, strolled in the flower gardens and seen something of the rural sports, the feasting, the jousting and the maskers and morris-dancers. We have marked the changes brought about by the dissolution of the monasteries, the struggle to maintain the hospitals of London and the Colleges of Oxford and Cambridge, and noted the poverty and destitution which existed side by side with profusion and extravagance in high places. We have passed from medieval times into the Elizabethan Age. As Froude said : " Now it is all gone—like an unsubstantial pageant faded ; and between us and the old English there lies a gulf of mystery which the prose of the historian will never adequately bridge."

Thomas Vicary lived like us in a state of transition, a time of unrest and of social upheaval, when old men dreamed dreams and young men saw visions. It was, as I have endeavoured to show, in medicine, surgery and public health, not a time of building but of laying foundations well and truly on which a future edifice was to arise ; not a time of harvest but a time in which the seeds of knowledge were sown. Linacre organized medicine and Vicary established surgery as learned professions. They thus opened the doors to the light of the Renaissance, brushed aside the cobwebs of the schoolmen, taught the value of independent thought, experiment and observation and rendered possible the epoch-making discovery of William Harvey, the investigations of John Hunter and the triumphs of medical research which continue up to the present day. Equally, we have traced the beginnings of social medicine and public health in the enlightened writings of Sir Thomas More and his administration.

For all this we honour the Oxford humanists and Thomas Vicary to-day. Each in our own way, whether our gifts be great or small, must follow the high aims the Tudor pioneers set before us to maintain health, to prevent and cure disease and to improve the lot of man.

" Let knowledge grow from more to more ;
But more of reverence in us dwell ;
That mind and soul according well,
May make one music as before."

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GANGRENE

Lecture delivered at the Royal College of Surgeons of England

on

10th April, 1947,

by

Major-General Philip H. Mitchiner, C.B., C.B.E., T.D.,
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GANGRENE is the term applied to the death in bulk of the body tissues and may affect to a various extent, all the tissues involved but as a general rule the more superficial tissues are more involved than the deeper, including bone. The term gangrene is more particularly applied to death of soft tissues ; the dead mass being referred to as a sphacelus or slough, a similar change in bone being referred to as necrosis and the mass of dead bone as a sequestrum. Gangrene is always the result of the cutting off of the blood supply of the living tissues and in its extreme form where the heart ceases to act, the failure of the circulation causes death at the vital centres in the medulla and pons with the result that death, as it is popularly known, results in these cases. The cutting off of the blood supply may be primarily arterial resulting from sudden blockage of the lumen of the vessel or its occlusion from pressure from without or the gradual narrowing of the lumen by disease and sclerosis in the vessel wall ; a process which ultimately leads to thrombosis and complete obliteration of the lumen of the vessel. On the other hand the circulation may be retarded by pressure on the veins obstructing the return venous flow and the oedema so produced in the tissues may ultimately reach sufficient pressure to obliterate the arterial flow. Such a condition occurs in true mesenteric thrombosis or in strangulation of the intestine in acute obstruction. It may appear to you that a discourse on either local or general death cannot be of much interest to the surgeon for it is very obvious that what is dead is dead and can be removed only either by a process of nature or by the art of the surgeon. The natural process of separation of the sphacelus of gangrenous tissue is by a line of ulceration which forms at the junction of the living and dead tissue and eats from the surface towards the centre of the affected area, producing a thin red line of granulation tissue which is known as the line of demarcation. Provided no infection is present, this separative process takes place at the expense of the dead tissue and when this has been cast off, usually not for many weeks, the patient is left with a conical stump uncovered with skin and which always needs surgical operation to trim and cover it. Therefore it is the practice of most surgeons to amputate through

healthy tissue as soon as a line of demarcation has formed and so ensure a more rapid and less painful convalescence.

The signs of gangrene are a cold insensitive area, which may be dead white or black in colour according as to whether it is empty or full of retained blood, as a general rule retention of blood causes the gangrenous area to be dark in colour. As has been already pointed out, the gangrenous process results from the cutting off of the blood supply of the part and this may occur in any one of the three following ways :—

(1) Owing to disease of the cardiovascular system usually affecting the valves of the heart, an embolus may be carried down the blood stream until it lodges at the bification of some vessel. In such a case the blood supply is suddenly cut off from the tissues beyond the point of blockage of the artery. There is intense pain at this point and as a result of the sudden cutting off of the arterial blood pressure, a reflux of venous blood into the area deprived of its blood supply. In addition there results that intense vascular spasm with oedema of tissues which always occurs with a lowering of the blood pressure. These two causes flood the damaged tissue with fluid and a *moist gangrene* results. Such a moist gangrene is primarily aseptic but unless great care is taken, pathogenic organisms will invade the dead tissue from the skin and cause sepsis to supervene when a septic moist gangrene results which presents a greenish-purple mass of stinking putrescence, semi-liquid and horrible.

(2) Where the blood supply is gradually cut off, due either to spasm or subsequent thickening of the inner coats of the vessel, with gradual obliteration of the lumen, gangrene will supervene ultimately, should slight trauma or infection occur. In such cases the arterial blood pressure has been gradually reduced as well as the volume of blood entering the tissues and the ultimate cutting off of the blood supply by the inflammatory process from tissues with adequate venous drainage results in the production of a dark mummified mass of *dry gangrene*. This is aseptic and usually remains so unless the infection causes suppuration to ensue when a moist septic gangrene develops. It should be noted that in this type of gangrene, the inflammatory reaction necessary to promote natural separation and a line of demarcation, is all too frequently sufficient to spread the gangrenous process and so a series of attempts at natural separation can be seen with a dull purple blush spreading beyond them into the dehydrated and exsanguinated limb beyond. Such a condition is sometimes described as a spreading or creeping gangrene and is commonly seen in old patients with arteriosclerosis. In this type of arteriosclerotic gangrene, it is often found as evidence both by arteriograms and visual evidence at operation, that the lower part of the femoral and popliteal arteries are completely obliterated by organised clot. For this reason, the treatment of this condition, even when involving only the digits of the foot, consists in the apparently drastic removal of the lower limb by circular amputation through the lower part of the thigh. Such an

operation ensures some hopes of blood supply to the stump being adequate and obviates the necessity of making skin flaps whose blood supply is always precarious even in a healthy individual. Amputation below the knee joint is seldom justifiable in these cases and if practised, all too frequently results in gangrene occurring in the skin flaps and even in the deeper tissues of the stump.

(3) Infection of the tissues by micro-organisms such as the clostridium welchii, etc., or even the more homely staphylococcus, may, by the toxaemia so produced or the pressure of effusion in areas poorly supplied with blood, produce an extensive liquefied necrosis of an infective type. Such cases are well exemplified in gas gangrene and carbuncle and are examples of *primary infective gangrene* which I do not propose to deal with to-day. In addition, as mentioned above, secondary infection occurs not infrequently in both moist and dry gangrene which are primarily aseptic in type and such *secondary infective gangrene* always calls for prompt surgical intervention to save the patient's life. Clinically therefore, we see that we are faced with dry and moist types of gangrene and that the moist type may be either aseptic or septic.

Let us now turn to a consideration of the aetiology of gangrene and for this purpose I append a table which epitomizes the main aetiological factors of this distressing condition.

1. Gangrene symptomatic of Cardio-Vascular Disease.
   - (A) Thrombotic
     - (i) From disease of the vessel wall
       - (a) Senile
       - (b) Non-Senile
     - (ii) From pressure without on the vessel wall
     - (iii) Traumatic (see below)
   - (B) Embolic
   - (C) Neuropathic
     - (i) Spasmodic—Raynaud's disease
     - (ii) Toxic—ergot—carbolic
     - (iii) Bed sores—trophic ulcers
2. Traumatic Gangrene
   - (A) Direct
   - (B) Indirect
3. Thermo-Chemical Gangrene
   - (A) Burns and scalds—heat
   - (B) Frost-bite—cold
   - (C) Escharotics
4. Infective Gangrene
   - (A) Acute inflammatory — pyogenic organisms. Carbuncle — Cancrum Oris — Noma vulvae — Phagedaena — Spreading subcutaneous gangrene
   - (B) Gas Gangrene—anaerobic organisms
5. Toxic Gangrene — diabetic gangrene

You may have noticed in your clinical experience that all these patients suffer from intense pain which is worse at night and causes sleeplessness and extreme mental distress and yet you know that gangrene produces death of tissue which is insensitive. How then, can we reconcile this condition of pain with the fact that insensitive dead tissue has resulted from the pathological cessation of the blood supply? The answer is to be found in the fact that in the ischæmic tissues the pain from imperfect oxygenation of the nerve endings is very considerable; as you may have noticed in your own extremities on a very cold day when the tingling and pain which accompanies the returning circulation causes extreme discomfort. Any variation in the congestion of the limb will cause a temporary increase of pain and so the elevation of the part on getting into bed at night or leaving it in the morning causes exacerbations of pain which are distressing and prevent rest. It is extremely difficult to treat this condition. Usually such patients will sleep more comfortably if the limb is left exposed to the colder air or hangs dependent from the bed but this is by no means always the case. Narcotic drugs often have to be resorted too and of these the most satisfactory in my experience is Nepenthe, 15-30 minims at night but often morphia has to be used. If as occurs where thickening and disease of the arterial walls are present, as in arteriosclerosis, diabetes and syphilis, or where a continual spasm of the arterial walls as in thrombo-angitis obliterans and more rarely in Raynaud's disease, results in their consequent thickening with subsequent clotting in the vessels, as happens in cases where there is disturbance of the nervous control or where certain poisons such as ergot produce a similar result, the blood supply is gradually cut off and dry gangrene results. Similarly, where division of the vessels to a part with an end blood supply such as the finger or appendix occurs either from accident or infection, then gangrene results which in the case of a digit is usually of the dry type and is known as indirect traumatic gangrene.

Mesenteric thrombosis, so called, offers two very interesting illustrations of different types of gangrene as well as an explanation of the very different clinical signs which are described as characteristic of this distressing condition. Embolus occurring in the mesenteric vessels usually in a patient suffering from valvular disease of the heart, results in sudden cessation of the circulation to a part of the intestine with ischæmia, oedema and colic, while the more commonly occurring thrombosis of the mesenteric veins frequently associated with a failing right heart leads to congestion and oedema, gradually developing with a feeling of discomfort and the passage of blood-stained stools. This latter is the type of true mesenteric thrombosis and the one in which conservative treatment is indicated and often successful for true gangrene of the bowel seldom occurs in such cases. Similar changes occur in the early stages of strangulation of the bowel by bands or in an external hernia but owing to the tightness of the stricture surrounding the congested bowel, obstruction of the arterial flow is induced by the oedema in the mesentry and gangrene

of the strangulated coil of intestine develops fairly rapidly. A similar change is seen in many cases of acute appendicitis due to cutting off of the arterial flow in the appendicular artery and in all these cases of course, infection of the dead tissue rapidly occurs with resultant spreading peritonitis. Similar changes are met with in acute suppurative osteitis (osteomyelitis) where the pressure of the exudate in the Haversian canals rapidly strangulates the blood supply, irritates the peripheral nerves and so causes rapid death of the bone associated with intense pain and toxaemia.

Carbolic Gangrene. An interesting condition now rarely seen, is that of carbolic gangrene which in the days when strong carbolic compresses were employed, was not infrequent, the dead part being white and ischæmic. Some authorities maintain that the gangrene resulted from pressure of the bandage but in as much as these cases only constituted a small percentage among the patients treated with carbolic dressings and as further, such patients frequently showed general signs of carbolic poisoning it is possible that there was genuine toxic element when it occurred.

We have indulged in the melancholy task of discussing death and as ever, when death has resulted, that which is dead cannot be cured but only removed, either slowly by a process of nature ; ulceration at the line of demarcation between the living and dead tissues, or rapidly and far more painlessly by surgical operation ; for the natural process of separation which occurs is both tedious and very painful and exhausting to the unfortunate patient. It may seem profitless and uninteresting to discuss death, either partial or complete so let us turn to the far more interesting thought as to how such death arises and may possibly be prevented—a very much more cheerful prospect.

As already mentioned, gangrene results from the cutting off of the blood supply and this may occur possibly as a result of the detachment of a clot from the valves of the diseased heart, indicated by the sudden and terrible pain at the point where the clot lodges in the limb, which below that point becomes cold, blue and swollen. If prompt action is taken, the artery can be opened and the clot sucked out and the circulation re-established before actual gangrene has occurred but such operation must be performed within an hour or two of the clot occurring and even so is not always successful in saving the limb alive.

In other conditions, as we have seen, gangrene results from the gradual obliteration of the vessel by disease as in diabetes and syphilis and here the prompt and early recognition and the efficient treatment of these diseases may often save a patient's limb and even life.

In those cases where over-action of the sympathetic nervous system causes spasm in the walls of the smaller blood vessels, a condition which usually affects both lower limbs as in thrombo-angitis obliterans, and may

affect both upper limbs also as in Raynaud's disease, it is essential to ascertain whether or not fibrous thickening of the vessel walls has resulted from continual spasm before undertaking the removal of the sympathetic ganglia controlling the nerve supply to the vessel, an operation which gives most satisfactory results in those cases where spasm alone is present. In order to ascertain that spasm alone is causing the reduction of the blood supply and blanching and coldness of the limb, it is necessary to apply tests to see whether the cutting out of the sympathetic inhibitory influences will cause restoration of the circulation as exhibited by a rise in temperature and the appearance of a pink flush in the affected limb. This may be simply carried out either by immersing the limb in hot water or by exposing it to further cold and noting if any alteration occurs in the appearance of the limb so treated but best of all is to administer a spinal anaesthetic in the case of the lower limbs or to infiltrate locally the stellato ganglion in the upper limb which will knock out the sympathetic system and if a spasm alone is present, the pink flush over the whole limb and a rise in skin temperature will be very rapid and obvious and show that sympathectomy will give satisfactory, if not always permanent, results.

Where such gangrene has resulted from over use of ergot, or its ingestion with diseased rye in the bread, discontinuance of the drug or the ingestion of the diseased flour will be followed by amelioration of the condition, but it must be understood that what is dead is dead and the recovery of circulation in already dead tissue is not to be expected. In the case of *infective gangrene* different lines of treatment will have to be adopted according to the micro-organism which is causing the infection. Taking the common carbuncle where infection from the staphylococci on the skin results in death of the avascular fatty subcutaneous tissue with subsequent necrosis of the over-lying skin, the use of chemotherapy, especially penicillin, has made a tremendous difference in the outlook and almost abolished the mortality of what was once a very serious condition. In order to be successful, penicillin must be administered promptly, at least 40,000 units being given intramuscularly every three hours until the patient's general and local condition improves, usually in three or four days. It must however, be realised that in late cases where gangrene of the subcutaneous tissues has already occurred, such dead tissue will need surgical removal in order to clear up the condition ; for in such cases, penicillin is only an adjunct to efficient surgery.

Summary

I have endeavoured in the foregoing somewhat disjointed remarks to point out to you that localised death of tissues is not without interest to the surgeon but that the prevention of this condition is of more vital importance to the patient and presents more interesting problems to the surgeon than the removal of the dead tissue when gangrene has occurred.

A HUNDRED YEARS OF GASTRIC SURGERY

An expanded version of an address delivered at the Centenary Meeting of the American Medical Association at Atlantic City on 11th June 1947

by

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Vice-President of the Royal College of Surgeons of England

A HUNDRED years is a long time, and the last hundred years have seen greater changes in the structure of human society than all the million ages that preceded them. In that century gastric surgery has been born, and grown to maturity.

About a hundred years ago, to be exact in 1850, the great physician Charles Meigs, of Philadelphia, wrote that he "frankly detested all abdominal surgery, save such as was warranted by imminent death." Yet in those years the foundations of abdominal surgery were laid. In 1846 Morton, a dentist and a medical student at Harvard, gave the first anaesthetic for a major abdominal operation performed by Dr. Warren. In 1849 the first known operation on the stomach, a gastrostomy for oesophageal obstruction, was performed, unfortunately without success, by Sedillot. Anaesthesia was the first of four advances that made the planned and curative gastric surgery of to-day possible. The others were the demonstration of the causes of infection by Lister in 1865, the discovery of X-Rays by Röntgen in 1895, and the evolution by Cannon in 1897 of a practical plan for visualising the digestive tract by radiography.

But while gastric surgery had perforce to await these discoveries, the study of gastric disease, which laid the basis of pathological knowledge on which gastric surgery is founded, proceeded with the progress of learning. In 1586 Marcellus Donatus of Mantua performed a post-mortem examination on one Camillus Jacinus, a man "of bilious disposition," who died after an acute illness during which he vomited three to five "pounds of phlegm" at a time. He describes how "in the lower part of the stomach at the pylorus or lower orifice the inner coating was ulcerated, and we had no doubt that this had been the cause of his malady." In 1737 Morgagni described gastric ulcer. In 1793 Matthew Baillie gave an account of the gross pathology and symptoms of gastric ulceration. In 1817 Travers reported two cases of duodenal ulcer in The Transactions of the London Medico-Chirugical Society. In 1829 Cruveilhier drew for the first time a clear distinction between cancer, gastritis and simple ulcer, but failed to mention ulceration of the duodenum. In 1830 John Abercrombie,

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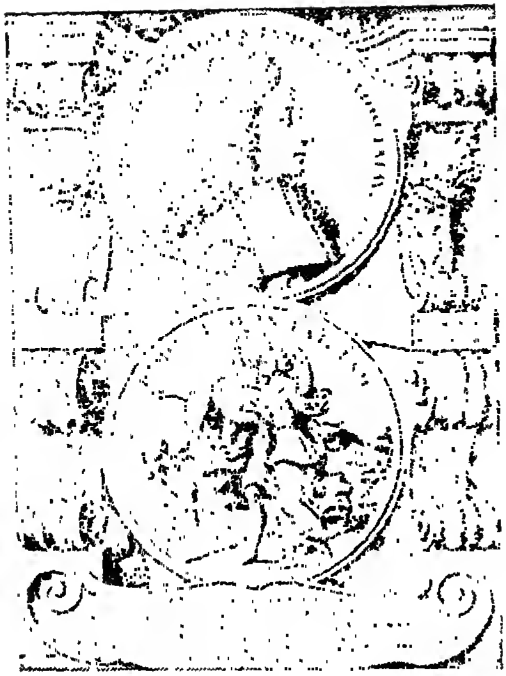
Charles Meigs

Lister

of Edinburgh, described five cases of duodenal ulcer, and gave the first clear description of the clinical aspects of the disease. In 1842 Curling reported for the first time the association of acute duodenal ulceration with burns.

Thus one hundred years ago the three diseases with which gastric surgery is concerned, gastric cancer, gastric ulcer and duodenal ulcer, were already well known. The first recorded operation on the stomach was Sedillot's gastrostomy in 1849, and two others, which survived two and four days respectively, were done at Guy's Hospital in 1858 and 1859 by Mr. Cooper Forster. It was not till 1875 that Sydney Jones performed the first successful gastrostomy. The same year, 1875, saw the first partial gastrectomy by Péan, but the first successful operation of this type was that of Billroth in 1881. Gastro-jejunostomy for cancer was performed in 1881 by Wolfler, of Vienna, and in the same year Courvoisier made an unsuccessful attempt to perform the operation on a patient with ulcer. In 1883 Kocher performed the first successful suture of a gunshot wound of the stomach. Langenbeck, in the Archives of Clinical Surgery, first proposed the suture of perforations, but Miculicz was the first to suture a perforated gastric ulcer, which he diagnosed by puncturing the distended abdomen with a trocar, and obtaining " inflammatory gas which stank of alcohol." Heusner, of Bremen, did the first successful suture of a perforated ulcer in a private house in 1892, taking three hours for the operation. Hastings Gilford, in 1893, was the first to suture a perforation in Great Britain, and Morse, of Norwich, was the first to report a success ; he writes " the stomach was washed out and the hole was closed with Lemberts, and then the abdomen was washed out with 17 pints of hot water at a temperature of 105°." In those pioneer days the courage of the surgeons was matched by the toughness of the patients.

From these early beginnings, gastric surgery developed rapidly, and, with the elimination of the bad and the dissemination of the good, it gradually came to assume a recognized structure. Gastro-jejunostomy by the posterior route, advocated by von Hacker in 1885, became the preferred method. In 1894 Jaboulay suggested gastro-duodenostomy, and in 1902 Roux advocated his method of gastro-jejunostomy en Y, a technique which now has a historic interest only. Partial gastrectomy soon became an established procedure. Randolph Winslow, of Baltimore, was the first surgeon to perform the operation in the United States, but by 1893 it was sufficiently standardised to call for a review in the Annals of Surgery of the resections performed up to that date, which showed a mortality of 41 per cent. Total gastrectomy was first attempted in 1884 by Phineas Connor, of Cincinnati, but Schlatter, of Zurich, was the first surgeon to remove the whole stomach successfully, a success repeated by McDonald in the United States in 1898. In 1929 Finney and Rienhoff were able to collect 122 cases of complete gastrectomy from the literature with a mortality of 41 per cent.



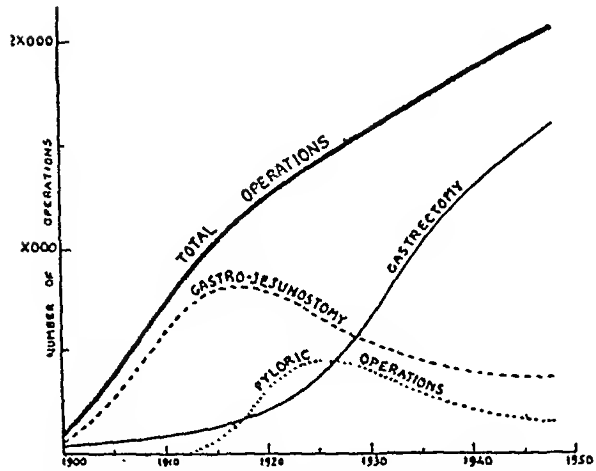
Morgagni

Within the second fifty years of the centenary under review the literature of gastric surgery has been too voluminous for analysis, but it may be said that since the beginning of the present century the technique of operation has been so perfected and the mortality so reduced that discussion has passed from the possibility or permissibility of gastric surgery to the technique of operations. In 1900 Mayo Robson claimed that all chronic gastric ulcers not responding to medical treatment should be subjected to surgery while the patient was still a good risk. In the same year W. J. Mayo declared cancer of the stomach to be a surgical disease. In 1905 Moynihan published the first book on the treating of gastric and duodenal ulcers, and the Mayo Clinic reported a series of 500 cases treated by operation.

In the early days of gastric surgery, when anaesthesia, instruments, materials, theatre technique, and pre- and post-operative methods were all crude according to modern standards, the choice of operation was dictated, above all, by considerations of the patient's safety. For cancer gastrectomy, growing more and more radical as technique improved, was, from the first, the recognised treatment. For ulcer, a distressing but not a mortal malady, the attempt to find an operation which would give permanent relief at small risk led to the adoption of a number of procedures which varied as views on the aetiology of ulceration changed. At first, the operation of gastro-jejunostomy held pride of place. It was simpler and safer than gastrectomy, and, after the first difficulties had been overcome, it was eminently satisfactory. The posterior operation became the rule, and, with the adoption of the no-loop or short-loop type of anastomosis, the mechanical obstruction which was a common sequel of the first operations was avoided. The operation was originally performed for cancer and for duodenal ulceration with pyloric stenosis, but, so excellent were the results, that it came later to be applied to the treatment of all ulcers, even those with no stenosis or even delay. Failures appeared, but at first they were few. In 1899 Braun described a post-operative jejunal ulcer. In 1905 Mayo Robson wrote a paper on gastro-jejunal ulceration, but looked upon it as a rare complication. With the increase in gastric surgery however, and particularly with the application of gastro-enterostomy to the treatment of earlier ulcers in younger patients, stomal ulceration became a problem to be reckoned with. Surgeons first sought for the explanation in some technical error, in the use of clamps or unabsorbable sutures or in the site or size of the opening, but they came to realise that the fault lay rather in performing the operation at all in patients with high acid and rapid emptying. Gastro-jejunostomy had its heyday from 1900 to 1925. In the early twenties doubts of its efficacy began to appear, and a group of operations round the pylorus, gastro-duodenostomy, pylorplasty, Finney's operation, and other variations of gastro-duodenal anastomosis, were introduced to overcome pyloric stenosis or spasm and promote early neutralisation of the gastric contents.

J. M. T. Finney

The Foundation House
Charles Mayo (seated), William Mayo (standing)



TRENDS OF ULCER SURGERY OVER FIFTY YEARS.

FIG. 1

These operations, in turn, shared the fate of gastro-jejunostomy. They proved to be less successful than their authors had hoped, and no more immune than the older operation from recurrent ulceration, and from the late twenties the operation of partial gastrectomy has assumed increasing importance in the treatment of gastric and duodenal ulceration.

One reason for the abandoning of short-circuiting operations was the demonstration that the neutralisation they achieved was illusory, and that the acid level, which showed an apparent drop in the immediate post-operative phase, returned a year later to its pre-operative level, or higher. Others were the increasing safety of the larger operation in practised hands, and the permanent acid reduction achieved by adequate resections. Partial gastrectomy, like gastro-jejunostomy, went through a period of intensive testing, during which the unsatisfactory methods were eliminated and the satisfactory ones improved. It has eventually emerged as a safe and satisfactory though by no means standardised procedure, that in average hands still has a high mortality, but that in the hands of the expert carries no greater risk than the older operations, and a far higher prospect of cure. For the past ten years a radical gastrectomy, that differs in design in different clinics but in all carries out certain basic principles, has been the accepted treatment for peptic ulceration among the great majority of gastric surgeons throughout the world. In experienced hands it has a mortality not exceeding 2 per cent., a cure rate of at least 90 per cent., and an incidence of recurrent ulceration of at most one per cent. Yet because in average clinics the risks of gastrectomy are four or five times as high and the prospects of cure less assured, alternative treatments are constantly sought. Where do we stand to-day?

The literature dealing with the aetiology of ulceration is not merely overwhelming, it is self-cancelling. Whatever we wish to believe, we can find evidence in experimental work to prove our theory. Ulcers have been

produced by dividing the vagi and cured by dividing the vagi ; they have been produced by ligating the gastric vessels and cured by the same means ; they have been produced by transplanting patches of jejunum to the stomach wall and cured by jejunal transplants. Nervous impulses, trauma, toxins, infection, irritants, malnutrition, vitamin deficiency, have all been implicated. Clinically family disposition, smoking, worry, *overwork, irregular meals, undernourishment, oral sepsis, and acute* infections all seem to play a part. The one factor on which there is unanimity is that of acid. Peptic ulcers occur only when and where there is hydrochloric acid ; they are common where it is high, rare where it is low, unknown where it is absent. Yet, though acid is associated with ulcer, it is not the cause. Most healthy men and women in the prime of life have a high acid level, but very few have ulcer. In their moments of supreme fitness their acid is highest and their chances of ulceration lowest.

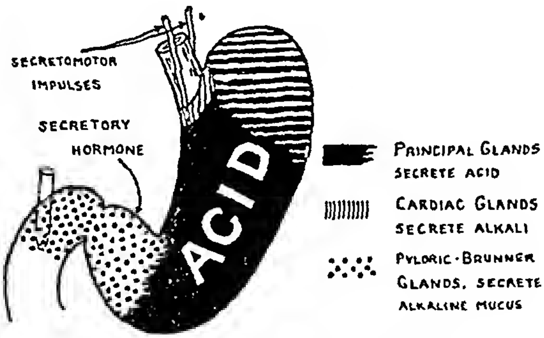
On other surfaces, such as the skin or the mucous lining of the mouth, we do not search for one cause of all lesions. Spots on the skin may be due to chemical irritants, thermal or mechanical injury, drugs, local or general infections, specific fevers. These spots usually heal and leave no trace behind them ; but if they occurred on a surface exposed to digestion they would persist and assume a uniform pattern.

An automobile may break down for many reasons. A tyre may go flat, a wheel may come off, a bolt may drop from the steering or transmission, a break may appear in the ignition system, a fly may choke a jet or a drop of water may block a gasolene pipe. The machine stops, the cause of failure is discovered and corrected, and then it goes on again. The mechanism of an aeroplane may go wrong for similar reasons, but in this case the result is usually permanent and usually the same—a mass of crumpled aluminium. We do not however try to prove a common cause. The causes are as varied as those that stop an automobile, but a secondary factor, that of gravity, comes in to make what is a temporary breakdown in the first case a permanent disaster in the second.

It is probable then that the causes of ulcer are as many and varied as the causes of skin spots and automobile breakdowns, but while lesions on the skin and mucous membranes are allowed to heal, those on a surface exposed to acid are digested away and become chronic ulcers, similar in each case whatever their first cause. The common sites of ulcer are not those where the primary lesion occurs most often, but those where the fixity of the part opposes healing and favours auto-digestion. But whether acid be the cause of ulcers or only the cause of their persistence, the surgical treatment of ulcer is bound up with a reduction in the acid level.

Many methods of reducing the acid level have been advocated, but four in particular, the short-circuiting operations, vaso-ligation, vagal section, and gastrectomy, must be considered to-day in relation to the mechanism of acid secretion which they are intended to modify.

Acid and pepsin are secreted by the principal glands of the stomach which in man occupy the whole body and fundus, in fact all of the stomach except for two areas, a small strip near the cardia and the pyloric antrum, which bear the cardiac and pyloric glands respectively. But the secretion



SECRETORY AREAS OF THE STOMACH

FIG. 2

potential is not equal throughout this acid-bearing area. In the body the mucous membrane is thick and rugose, carrying deep glands and thrown into numerous tall folds which increase its secreting surface very greatly; in the fundus it is smooth, thin, and carries simpler and shorter glands. This secreting surface pours out acid in response to stimuli of two kinds, nervous and hormonic. Secretomotor impulses are transmitted by the vagi, and are called forth by the anticipation, sight or smell of food, and by the pleasure in eating which man experiences in the early stages of a meal and the dog at all times; they are abolished by vagal section. The hormone which evokes acid secretion is formed in the mucous membrane of the pyloric antrum, and to a much lesser extent in that of the duodenum and upper jejunum, in the presence of the products of gastric digestion, such as peptone. The hormonically induced flow of acid remains after vagal section.

The purpose of this double mechanism is clear. Gastric digestion is a prolonged process whose main task is to release meat fibres from their connective tissue envelope and reduce their proteins to simpler fractions. Meat meals, to the animal and to man under natural surroundings, come suddenly and unexpectedly, and some rapid mechanism for preparing a digestive medium into which they shall be received is essential. But when hunger is sated gastric digestion is by no means finished, and the hormone provides a slow and automatically regulated mechanism for keeping up the flow of digestive juice as long as there is anything in the stomach to digest.

The relative part played by these two mechanisms in man is unsettled. Most experiments on gastric digestion have been done on the dog, an animal that eats seldom, but with indecent haste and unconcealed joy. These experiments have led to an undue emphasis on the vagal mechanism in gastric secretion. Man eats from habit rather than hunger, and in decent society he takes about half an hour to get through a meal; but he retains the meal in his stomach for a further two hours, during the whole of which he is renewing the acid bath in which digestion is taking place. It is therefore reasonable to suppose that in the human stomach the hormonic mechanism exceeds in importance the nervous one, and equally reasonable to suggest that the ulcer diathesis is characterised by hormonic misdemeanour rather than by vagal overaction. The ulcer patient is distinguished, less by his high acid level, than by his habit of secreting acid at all times, not only when he is eating but between meals and when he is asleep.

The acid curve of the usual fractional test meal shows two humps, like the Bactrian camel, a characteristic contour that is usually accepted without comment. It may be suggested, not as a statement of fact but

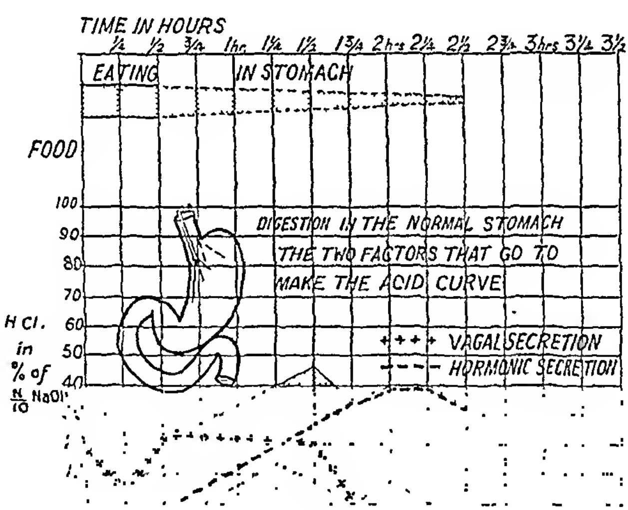


FIG. 3

as a hypothesis to excite controversy, that the first hump represents the vagal secretion called forth by the meal, the second the late hormonic secretion, and the valley between them the change-over period after the meal is finished and before the after-flow has got into its stride. With this outline of the mechanism of gastric secretion in mind, we may examine the four groups of operations advocated for the cure of peptic ulceration.

The short-circuiting operations do nothing to reduce acid production, but leave unaffected the acid-bearing mucous surfaces and the nervous and hormonic influences which cause them to secrete. They were designed

to bring about neutralisation of the acid gastric contents by allowing alkaline juices to enter the stomach, a mechanism that was thought to be the normal one. It is however doubtful if any part of the alimentary tract works backwards except in the cow; on the contrary each segment

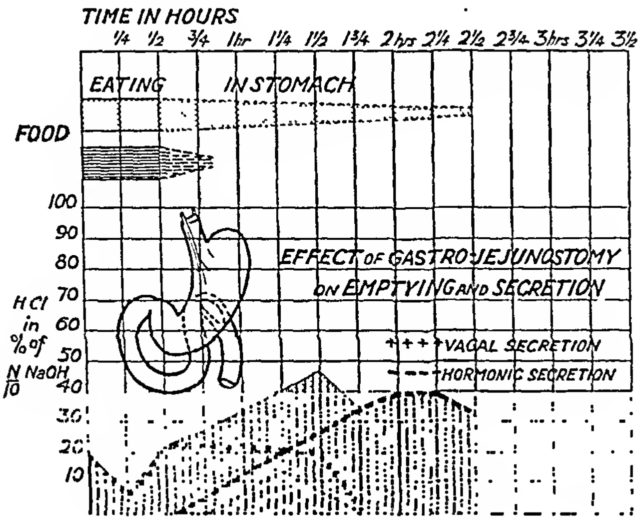


FIG. 4

does its allotted job in the digestive process, and hands the result along the production band to the next department. The stomach, having reduced the meal to chyme, pushes it on to the duodenum and shuts down secretion till the next meal. Bile seldom appears in the normal stomach, and still more rarely in the hypertonic and rapidly emptying stomach of the duodenal ulcer patient, either before or after gastro-jejunostomy. The constant result of gastro-enteric anastomosis is that food leaves the stomach shortly after it has been eaten, so that the second wave of acid, when it comes, is poured onto a mucous membrane unprotected by food. The unsatisfactory results of short-circuiting operations when performed on patients whose acid mechanism survives or is capable of survival, are by now notorious.

Vaso-ligation has enjoyed a certain vogue in Britain. The operation consists in ligating so many of the gastric vessels that the blood supply of the stomach is reduced to a point just short of gangrene. It was propounded ten years ago by Wilson Hey of Manchester and has lately been advocated by Somerville of Travancore, and is unique in that it is designed to reduce radically the ability of the gastric membrane to secrete acid while leaving the shape and nerve supply of the stomach intact In theory it seems unlikely that secretion can be abolished by such means without at the same time harming the neuro-muscular mechanism, and in practice the operation has not been sufficiently successful to persuade those most competent to judge, the colleagues of the authors in Lancashire and India, to adopt it.

Vagal section has a more scientific basis, since all experimental work has emphasised the importance of the nervous mechanism in gastric secretion. Dragstedt's pioneer work on dogs, and the strikingly successful results which he and the many surgeons who have followed him have obtained in treating human beings suffering from peptic ulceration, have placed the operation of supra-diaphragmatic vagotomy in the forefront of contemporary interest. It is odious to criticise the darling of the moment, whether in films, sport or surgical technique, but it would be well, before we rush into the operation wholesale, to ask whether it has drawbacks as well as advantages, whether it is indeed the answer to the gastric surgeon's prayer. Vagotomy diminishes very profoundly the quantity and acid level of gastric secretion in so far as that secretion follows nervous stimuli.

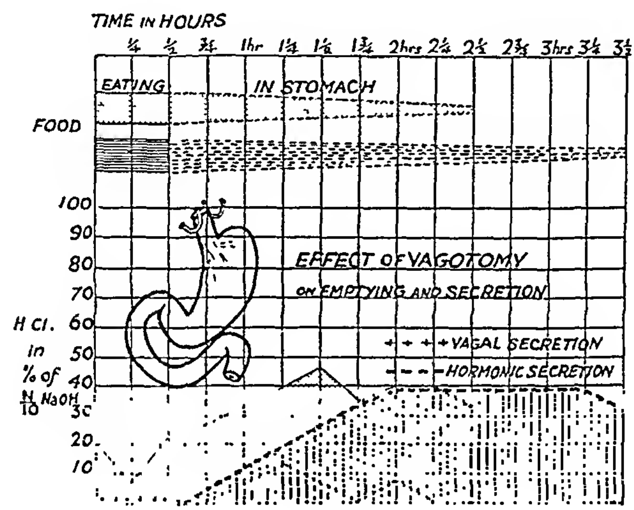


FIG. 5

It does not reduce the glandular basis of acid production, it does not affect the hormonic mechanism of after-secretion, it does not remove the deformity or the fixation to surrounding structures which are the causes of many of the effects of ulceration, and it has a tendency to delay emptying and promote distention. It may be therefore that vagotomy will eventually assume a place akin to that of the flame-throwing tank in modern warfare, a useful weapon for eliminating pockets of stubborn resistance. Those incurably ulcer-prone patients, whose ulcers recur even after the most radical resections skilfully performed, will have cause to bless the name of Dragstedt.

To bring back an old star for an encore while her rival holds the stage is a task as thankless as criticising the new favourite. Nevertheless we must ask ourselves if we have, in fact, any alternative treatment for

ulceration that can rival radical gastrectomy in the satisfactory nature and permanence of its results. The word "radical" is used advisedly, for gastric resection may mean anything from pyloric circumcision to a planned and effective removal. The requirements of radical gastrectomy are threefold. Firstly it must remove the whole of the high convoluted mucous membrane of the body and leave only the thin low-secreting layer of the fundus, that is it must take three-quarters of the stomach.

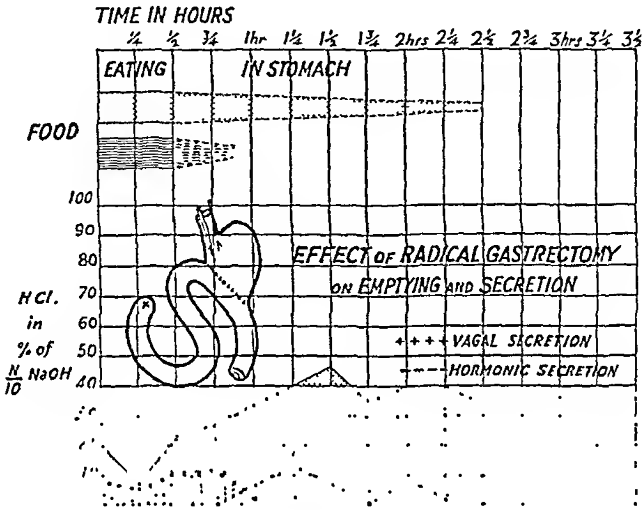


FIG. 6

Secondly it must remove the whole of the antrum or antral mucous membrane as far as the pylorus, so that no further acid shall be secreted when the food has left the small stomach, as it will do in about twenty minutes. Thirdly it must divide the soft tissues on the lesser curve as far as the cardia, and so cut off more than half the vagal supply.

A gastrectomy so performed reduces the acid secretion profoundly and permanently and limits its outflow to the time that food is in the stomach. It gives results that are uniformly excellent, and still remains the standard by which other operations are judged.

I should like to express my grateful thanks for the help I have been given in writing this review by Colonel W. Connell, Mr. Charles Nicholas, Miss Margaret Louden and Miss Muriel Waterfall. W. H. O.

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THE LIBRARY DURING THE WAR

by

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THE COLLEGE library having safely survived the war and having been re-assembled intact from its scattered places of evacuation, it is well to put on record something of its adventures between 1941 and 1945. At the same time it will be useful to indicate the size and content of the various collections which now go to make up this library, the second largest special medical collection in the Empire.

In the two years immediately before war broke out, the Council had been giving special attention to the organisation and equipment of the library and the re-arrangement of the books in such a way that they could be readily accessible in their various groups. It was just fifty years since the library had had such an overhaul, and those fifty years had been for all libraries a period of unprecedented growth. The College's collection had doubled its extent. As happened to so many old libraries the available space could not provide room for a systematic arrangement of the different classes of books. The growing collection was housed in whatever scattered rooms could be fitted with shelves, with little regard to prompt and convenient service for readers. In 1937 a large store was equipped with modern steel shelving in the basement to co-ordinate these scattered stores.

The continuous policy of the Council in building up the library has been to provide a scientific reference library for surgeons and at the same time to maintain the original intention of the fathers of the College " that the library should illustrate the Hunterian Museum " and provide the literature necessary to the work of the museum's scientific staff. Broadly speaking, the result of this policy has been the formation of a library rich in the literature of surgery and its specialties, both historical and contemporary, and of the sciences which John Hunter himself cultivated—anatomy, physiology and pathology, both human and comparative. The collection of anatomy books is one of the most striking possessions of the College.

During the nineteenth century the College was the only medical body in London which maintained an active library freely open to the profession. It was then still possible, before the growth of American competition, for a working library unendowed with funds for luxuries to collect the classics of medicine on a thorough system. That was also the period of the first great development of periodical literature, which was growing up and expanding in the effort to publish promptly the spate of new observa-

tions and researches. Journals came to be numbered in hundreds and even thousands. The College thus built up a library rich in the basic literature of medical science and a widely representative collection of series of periodicals. With the turn of the century a number of specialist libraries were started in London, and at the same time the libraries of the Royal Society of Medicine and the British Medical Association began to develop as active general libraries of medicine. It thus became possible for the College to specialise its collections to the special needs of surgeons and its scientific staff. Since 1938 the Council has steadily pursued a policy of pruning out the non-medical books collected in the past century, chiefly of general science or natural history. An authority on library problems has recently suggested that in an ideal world every professional interest should have at least two large libraries devoted to it in such a centre as London: one a lending library and the other a reference library. For medical science the College library is specially suited to serve as the reference library. The value and usefulness of a living library of this kind depends on its resources in periodicals. Almost all original scientific work and new clinical observation is first made known through the journals and the systematic collection and preservation of these journals, which are too numerous, costly and space-consuming for any private library, have become the chief care of institutional libraries. The College is most fortunate in the extent and range of its collection of the basic periodicals of medical science as well as of the specialist surgical journals. It may be possible to give a survey of the main features of this collection in a subsequent article.

When, in the winter of 1940-41 it became necessary for libraries of all kinds in London to consider dispersal, it was evident that it would be rash to retain in the danger zone the College library with its special character of a basic reference collection. Arrangements were hurriedly made at the height of the air-raids to evacuate all but a very small working collection of current books. With the help of a generous grant from the Rockefeller Foundation some 100,000 volumes were transported to the West country. The heavy cost of maintaining the library while away and of bringing it back to London in 1945 was borne by the College. The wisdom of this decision of the Council became clear when the losses of other libraries and publishers' stocks by enemy action became known. Seventeen large libraries in central London were almost completely destroyed, including the College's near neighbours the great law libraries of Gray's Inn and the Inner Temple. When the disaster befell the Museum in May 1941 the large library store in the basement, mentioned above, was flooded by the water pumped onto the burning museum. The books and shelves had been moved from it in the previous two months. Had they still been there, more than three-quarters of the library collections would have been damaged beyond recovery. The ceilings of the Reading Room and the library office were severely damaged and the windows and window-frames almost all destroyed—by a freak of the blast-waves one large

window survived intact. The Reading Room had to be closed for many months while scaffolding was set up for inserting new girders above the ceiling to carry the weight of the upper floors. Thanks to the evacuation, only a very small number of modern books and parts of journals were damaged, most of which it has been possible to replace.

Already in the summer of 1939 the most valuable historical treasures from the library had been sent with the famous portraits from the Council Room for safe keeping at the National Library of Wales at Aberystwyth. What books were selected as most in need of this care ? First, the irreplaceable manuscripts ; for instance, John Hunter's drafts of his books on the Teeth and on the Venereal Disease, with the drawings from which their plates were engraved. With these went the wonderful series of letters which Hunter wrote to Edward Jenner during nearly 20 years and which Jenner preserved as his most cherished possessions. There is the original paper which Jenner wrote on Cow-pox in 1797 and which he revised and published a year later. Ultimately of even more interest than these will be the great collection of Lister's papers presented to the College by his nephew Sir Rickman Godlee, a past President; included among these are Pasteur's letters to Lister. From the printed books were chosen the *incunabula*, books printed before 1500, of which the College possesses 56 —a small collection but containing some rare items from the early printing-presses of France, Germany and the Low Countries, as well as beautiful Italian books such as the first edition of Celsus on Medicine, printed for the Printers' Guild of Florence in 1478, or Ketham's Anatomy, with its handsome woodcut illustrations, printed at Venice in 1495. These are followed by the great Renaissance anatomy books; the College's copy of Vesalius on the Fabric of the Human Body, the second edition printed at Basel in 1555, is one of the finest copies known, in a contemporary pigskin binding stamped with allegorical designs. From the seventeenth century is the first edition of Harvey on the Motion of the Heart and Blood, printed at Frankfurt in 1628 by William Fitzer, an Englishman who had settled there ; from the eighteenth century the original editions of Hunter's and Jenner's books. Almost every outstanding name in the history of medicine is represented by one or more contemporary editions and it was from these that the choice was made in the summer of 1939.

When the decision was taken in the winter of 1940-41 to evacuate the library as a whole, the College was lucky in obtaining good accommodation where it was possible to set up the steel shelving from the book-store and house the books in dry and airy conditions. Mr. Seymour Barling, C.M.G., Professor of Surgery at Birmingham and at that time a Member of Council, leased to the College two granary barns and a large room in the house at Alfrick Court, near Worcester, his country place, which provided space for some 60,000 books. Here were stored the long series of nineteenth century periodicals, most of the older books of secondary importance, and all the manuscripts remaining after the choice papers

had been sent to Wales. The rest of the library was housed at Downton Castle near Ludlow, where Mr. C. A. Boughton Knight, D.L., generously provided space in the unused parts of the Castle, which he had offered to the British Red Cross Society for use as a hospital, but which was impracticable for that purpose. Here were sent some 40,000 volumes comprising the main collection of medical and surgical textbooks, the books of reference and the series of periodicals of the last 25 years removed from the Reading Room. Here too were stored in steel cupboards and safes the College charters and the manuscript minute books of the Council and the Court of Examiners dating in unbroken series from 1745. The Hunterian and other pictures from the museum collection were also stored at Alfrick Court, and the splendid collection from the library of between 2,000 and 3,000 engraved portraits of medical men was half at Alfrick and half at Downton. As it had been possible to move the shelving from London and set it up in the country, it was practicable to carry on during the four years of evacuation the work of separating the various classes of the books—periodicals, historical books, books of the specialties—which had been begun in 1937, preparatory to the time when the library will be reorganised in the rebuilt College. The irrelevant books, on botany, geology, etc. were also separated out and these were sold as soon as the library was once again in London at the end of the war. While the greater part of the library was thus evacuated, one room remained open in London throughout the war, except for a short period immediately after the bombing. Here were available the current textbooks and new periodicals. Some 3,000 volumes of recent periodicals were generously housed by the Royal Society of Medicine at their store at St. Albans.

Besides the ordinary reference work of the library, the answering of enquiries for literary and bibliographical information and the loan of books to other medical libraries or to the College's evacuated scientific staff, as well as the maintenance of the current collections with new publications, the College undertook three special wartime activities. During the first winter of the war a small medical library was organised at the Army Medical Base at Dieppe which was supplied with the newest textbooks in every branch of medicine and a representative series of English, French and American periodicals. This library had to be abandoned at the fall of France. The College also joined with the Royal College of Physicians in providing periodicals for circulation among the medical officers of the Royal Naval Hospitals in Great Britain; all the more important British and American surgical and specialty journals were supplied throughout the war by the College. The close bond between the College and the Royal Australasian College of Surgeons found practical expression when the College undertook the buying of surgical books, both historical and new publications, for the Gordon Craig Library of the R.A.C.S. at Melbourne in the years when difficulty of transport and communication made direct orders from Australia impossible.

THE PAST, PRESENT AND FUTURE OF THE MUSEUM OF PATHOLOGY

By

Professor R. Willis

William Collins Professor of Pathology,
Royal College of Surgeons of England

Of about 8,000 pathological specimens formerly in the Hunterian Museum about 3,800 survived the 1941 disaster. In 1945 and 1946, these were reassembled and sorted, and were reviewed specimen by specimen as regards suitability for future display purposes, their intrinsic, merits as specimens, their historical value, their state of preservation, the adequacy of the records and the likelihood of obtaining satisfactory microscopical preparations. The discard of useless specimens reduced the total number of specimens suitable as the basis for a new museum to 2,800.

The losses sustained affected some sections much more than others. Thus of the original collection of over 2,000 specimens in General Pathology, scarcely any survived; and in Special Pathology the losses were serious in diseases of the skin, muscles, alimentary canal, urinary tract, genitalia, breast, endocrine system and haemopoietic system. The least damaged sections were those showing the special pathology of the skeleton, respiratory tract, nervous system and vascular system; in particular, the large collection of skeletal specimens was almost complete. The teratological collection also survived almost intact. Accessions during the last five years have filled many of the worst gaps in the alimentary and urinary systems, but it will take longer to remedy the defects in the genital, endocrine and haemopoietic systems. The residuum of the old collection is now on display in Room III, which it fully occupies.

The resorting and reclassification of our material involved a complete departure from the former method of classification and labelling. Because of the accumulation of specimens and the need for constant interpolation, the old method had become very cumbersome and in need of drastic revision. It was therefore decided to adopt a new method whereby interpolations can be made without disturbing the numerical sequence or labelling. This system has been used to tabulate the contents of the display stands, and for the time being it must serve in place of detailed catalogues. Most of the catalogues were destroyed and before new ones can be issued a careful revision of the entire contents of the

Museum, especially with respect to histological examination (all previous histological preparations have been destroyed) must be carried out.

Since 1942, 1,400 new specimens have been donated. During the last two years, these have all been examined and recorded, and about 400 of them have provided useful museum material. They have filled some of the most serious defects in the old collection, especially in the alimentary and urinary systems. Because of limited accommodation and the difficulty of securing suitable glassware, most of these accessions could not be mounted permanently at once; we have had to be content to dissect and prepare them, carry out any microscopical study necessary, and then seal them for security in temporary jars, from which they can readily be transferred to their permanent display jars, as these become available and as time and technical help permit. For the same reasons, increasingly stringent selection of specimens offered to the Museum has become necessary. Clearly, while we need a good inflow of specimens from which to select, under our present difficult conditions we should not burden ourselves by amassing a large quantity of material of a kind which can easily be obtained at any future time. We are therefore concentrating on filling our worst gaps and on rare or particularly excellent specimens. Fortunately most donors recognize that stringent selection is called for, and do not expect us to hoard up their surgical trophies unless they fill a real need in the collection.

For the guidance of donors it is hoped to publish at intervals specific requests for specimens in certain deficient sections of the museum, but in general it may be said that we are anxious to receive any rare or superlatively good specimens of any kind, but that we must defer the collection of more ordinary things which can be easily obtained at any time in the future from the operating theatre and the post-mortem room. It will not be amiss to mention certain classes of specimens which are *not* welcome. We do not collect huge specimens merely because they are huge. These are expensive and difficult to handle, occupy space quite disproportionate to their scientific value, and at present indeed glassware shortage prohibits proper mounting or storage of them. Nor can we accommodate specimens which show only methods of treatment or their results rather than pathological processes. Improper preliminary treatment and poor fixation make many a good specimen unusable; this is the greatest single factor responsible for discards. Over and over again in reviewing our material we discover that initial faulty fixation, especially in the centre of a bulky specimen, leads to discoloration of specimen and fluid alike. For this reason we welcome the receipt of fresh unfixed specimens immediately after their removal. Specimens kept for several days in a refrigerator are nearly always a disappointment.

As to the general intention and scope of the future museum, it should embrace the whole of pathology as a basic science without disproportionate emphasis on any special aspect or application of it. It should meet the

needs of advanced students and research workers and should be not merely a reduplication of the ordinary teaching museum of a medical school, but a repository of rare specimens and of research material. It should contain plentiful specimens of animal diseases which should be displayed along with their human counterparts for comparison, and it should include also a special section showing the methods and results of experimental pathology. It should develop a comprehensive collection of microscopical preparations, not only of gross specimens displayed in the museum but also of selected material of which only microscopical slides are available. Eventually it should amass a large collection of stored specimens of research value, but this is impracticable at present.

So far the reclassification of the Museum has been on regional lines as in the former Museum of Special Pathology, but when accommodation permits it is intended to build up also a section of General Pathology illustrating groups of diseases rather than regions. It is also intended to devote special rooms to the display of specimens showing research methods and results, to specimens of historical interest, and to other particular displays which may from time to time be set up for teaching or other purposes.

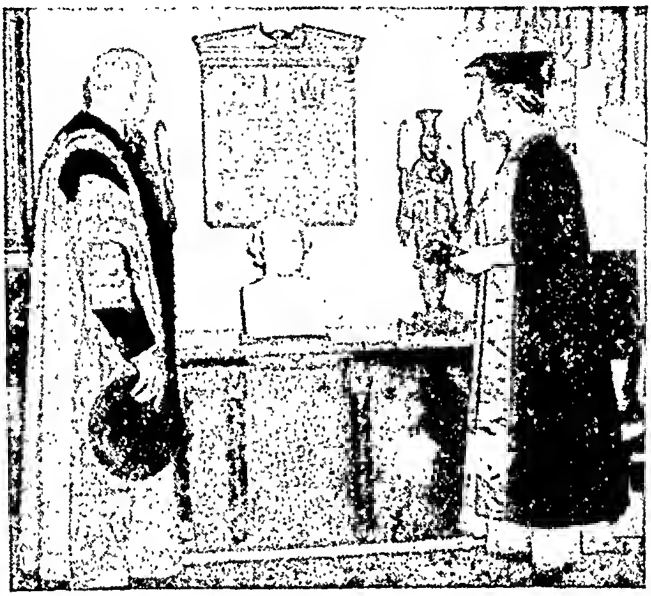
The development of the Pathology Museum as a teaching instrument must be kept constantly in mind. We are already using it as such in the series of lecture demonstrations which the College is giving twice yearly. But these cater for only small groups of enrolled students; we must aim to restore the Collection to such a condition that it can be used for self-instruction by all who enter its doors. This calls for a great deal more histological work and the still greater task of recataloguing and re-indexing—tasks which as yet have barely been begun.

ANAESTHESIA CENTENARY

The President and Council of the College held an evening reception on October 30, 1946, which was graced by the presence of H.R.H. the Princess Royal, herself an Honorary Fellow of the College, to mark the one hundredth anniversary of the first administration of ether at a surgical operation in Great Britain. The reception was held on behalf of the Association of Anaesthetists of Great Britain and Ireland, which is now closely linked with the College through its invited representative on the College Council and its use of the Joint Secretariat established by the College for the specialist associations at 45 Lincoln's Inn Fields. The President of the Association, Dr. A. D. Marston, M.R.C.S., D.A., delivered a learned and inspiring address, before a crowded audience and in the presence of Her Royal Highness and the President and Council of the College, on the four British pioneers of anaesthesia. Dr. Marston's address has been published in full in his Association's journal *Anaesthesia*, October 1946, vol. 1, pages 9-17. He recalled that on Monday December 21, 1846, Robert Liston amputated the leg of a patient under ether anaesthesia at University College Hospital. Then he dealt with the careers of Henry Hill Hickman, the pioneer of experiments in the use of carbonic acid gas and nitrous oxide, who died at the age of 29 with his proposals for anaesthesia unaccepted; of James Young Simpson, the famous Edinburgh obstetrician; of John Snow, who became the first regular anaesthetist at a London hospital, first at St. George's, and later also at University College Hospital for Robert Liston, "the busiest and most brilliant surgeon of his day"; and finally of Joseph Thomas Clover, who "restored ether to its role as the principal routine anaesthetic agent, and spent years in perfecting his world famous ether inhaler" which is still useful and efficient after seventy years. Dr. Marston pointed out that of the three Englishmen, whose names he had recorded beside the Scotsman Simpson's, one—Clover—was a Fellow and the other two were Members of the College, so that a more suitable place for the keeping of their memory could not well be thought of than within the precincts of the College which was their Alma Mater.

When the company had moved from the lecture theatre to the central hall of the College the President, Sir Alfred Webb Johnson, wearing his presidential robes, invited the Princess Royal, who wore the gown of her honorary Fellowship, to perform the special ceremony of the evening and unveil the tablet which had been presented by the Association of Anaesthetists. Her Royal Highness spoke of the "little friendly rivalry between America and Britain in regard to priority in the actual use of anaesthetics for surgical operations, but our cousins from across the Atlantic," her Royal Highness said, "would be among the first to give

credit to the British pioneers and to acclaim their contributions to the advancement of the science and art of anaesthesia. The British people are inclined to be too modest, but we do well to remember that in the history of medicine we can claim a very practical advance of the very first rank —vaccination, anaesthesia, preventive medicine, antiseptic surgery and scientific nursing—which were described by Sir William Osler as 'the captain jewels in the carcanet of the profession, beside which can be placed no others of equal lustre.'"



By kind permission of The Times

The tablet, which the Princess Royal then unveiled, is of bronze with a simple pediment above the coats of arms of the College and the Association enamelled in colour, with the following inscription :

> This tablet was erected in the Royal College of Surgeons of England by the Association of Anaesthetists of Great Britain and Ireland to mark the centenary of the first operation under anaesthesia in this country and to keep the memory of four British pioneers whose names will be held in honour from generation to generation—Henry Hill Hickman—James Simpson—John Snow—Joseph Thomas Clover.

After the ceremony the guests inspected an exhibition of historic and modern anaesthetic apparatus in the Council room.

DIARY FOR JULY

Tues. 15	3.45	PROF. J. KIRK—Anatomy of Cerebro-spinal Fluid.
	5.00	PROF. E. C. DODDS—Hormones.
Wed. 16	3.45	DR. M. KREMER—Visceral Sensation.
	5.00	MRS. E. K. DAWSON—Mammary Cancer (i): its genesis and spread.
Thur. 17	3.45	DR. E. L. PATTERSON—Ductless Glands (i).
	5.00	MRS. E. K. DAWSON—Mammary Cancer (ii): its diagnosis and prognosis, based on a simplified classification.
	6.15	PROF. J. G. TURNER—Charles Tomes Lecture—Movements of Teeth
Fri. 18		D.O.M.S. and D.Phys.Med. Examinations (Part I) begin.
	3.45	DR. E. L. PATTERSON—Ductless Glands (ii).
	5.00	PROF. S. L. BAKER—Fracture Callus.
Mon. 21	3.45	DR. T. E. BARLOW—Lungs.
	5.00	DR. CUTHBERT DUKES—The Pathology of Genito-Urinary Tuberculosis.
Tues. 22	3.45	PROF. G. R. DE BEER—Segmentation of Vertebrate Head.
	5.00	MRS. G. M. BONSER—The Pigmented Tumours of the Skin.
Wed. 23		Primary Fellowship Examination begins.
	3.45	DR. J. WHILLIS—Mouth and Pharynx (i).
	5.00	MRS. G. M. BONSER—Experimental Cancer of the Bladder: its relation to the industrial disease.
Thur. 24		D.T.M. & H. Examination begins.
	3.45	DR. J. WHILLIS—Mouth and Pharynx (ii).
	5.00	PROF. R. J. V. PULVERTRAFT—Post-operative Pulmonary Embolism.
	6.15	PROF. EVELYN SPRAWSON—Charles Tomes Lecture—Foods and Feeding as they affect teeth and their Environment.
Fri. 25		D.O.M.S. and D.Phys.Med. Examinations (Part II) begin.
	3.45	DR. A. PEACOCK—Nasal Sinuses and Cavity.
	5.00	DR. R. E. REWELL—Diseases Common to Man and Other Animals.
Mon. 28	3.45	DR. M. KREMER—Motor Functions of the Cerebral Cortex.
	5.00	DR. T. SYMINGTON—Some Clinical and Pathological aspects of Phæochromocytoma.
Tues. 29	3.45	PROF. F. WOOD JONES—Human Myology (i).
	5.00	DR. KEITH SIMPSON—The Pathology of Sudden Death.
Wed. 30	3.45	PROF. F. WOOD JONES—Human Myology (ii).
	5.00	DR. G. POPJÁK—The Nature of Parenchymatous and Fatty Degeneration.
Thur. 31	3.45	PROF. W. HAMILTON—The Early Stages of the Ovum.
	5.00	PROF. R. WILLIS—Some Embryological Principles in Pathology (i).
	6.15	PROF. H. W. RODGERS—Hunterian Lecture—The Results of Gunshot Wounds of the Abdomen.

The Practical Course for the Primary Fellowship Examination will be held at the College throughout August. The College will be closed for all other purposes during August.

THE NEW ROYAL CHARTER—1947

THE Royal College of Surgeons was incorporated by Royal Charter in 1800 and since then eight supplemental Charters have been granted:—1822 (New titles of President, Vice-Presidents and Council): 1843 (Inauguration of the Fellowship): 1852 (Election to the Fellowship): 1859 (Inauguration of Licence in Dental Surgery): 1888 (Council Election by postal vote): 1899 (Honorary Fellows): 1926 (Full rights for women diplomates of the College who had been eligible for the Diplomas of the College since 1909)—And now the 1947 Charter.

It has been apparent for some time that the College has a large and increasing part to play in post-graduate education. All those in touch with the College will know that a considerable number of post-graduate lecture courses and practical classes have been taking place. These courses have been in the basic medical sciences and in surgery and surgical and allied specialties and have been extremely useful and popular. The Council has therefore taken the first possible opportunity of applying for a Supplemental Charter to co-ordinate these activities, to allow for expansion, and for dealing with certain other matters. The following notes explain briefly the steps which the Council has taken.

A Fellowship in Dental Surgery (F.D.S., R.C.S.) has been established. The need for this has long been realised and it is the intention to make the standard as high in Dental Surgery as it is in General Surgery. The Council has power to confer the F.D.S. on 250 selected qualified Dental Surgeons without examination.

It is now lawful for the Council to establish such Faculties in the College as may be thought fit. The first to be established is in Dental Surgery and the first meeting of its Board at which Professor Bradlaw was elected Chairman of the Faculty of Dental Surgery, took place last month.

With regard to the Fellowship of the College authority has now been given to enable Ophthalmological and Otolaryngological candidates after passing the normal Primary Examination to take a Special Final Examination mainly in these subjects, and if successful to be admitted to the Fellowship.

It is now permissible for the College to provide collegiate and social amenities for students. Preliminary drawings have already been made for building a hostel on the site to the east of the present College buildings.

At the request of Fellows the Charter provides that in future no Member of the Council other than the President for the time being shall hold office for more than sixteen years.

In order that the Council may be as representative as possible of all branches of practice it is now permissible to co-opt eight additional members to the Council.

In addition the Council may now elect annually six Members or non-members of twenty years' standing to the Fellowship.

From the foregoing it would appear that a case has been made out for calling the 1947 Charter—"The Educational Charter." In any event another very important milestone has been reached in the history of the College. No time has been lost in implementing the provisions of the Charter and fulfilling still further the true functions of the College—The Promotion of the Art and Science of Surgery.

PAINFUL TUMOURS OF THE SKIN

Post-Graduate Lecture given at The Royal College of Surgeons of England

on

28th February, 1947

by

A. C. Lendrum, M.A., M.D.

The Department of Pathology, The University and
Western Infirmary, Glasgow

In 1812 Wood of Edinburgh described a small painful subcutaneous nodule or tubercle with a striking clinical picture, characterised by extraordinary pain and successfully treated by surgical extirpation. As far as morbid anatomy was concerned, this was of course in pre-microscopic days. In 1854 Virchow described the microscopic appearances of the tumours in a case with multiple cutaneous leiomyomata, a case with a clinical picture that closely resembled Wood's descriptions. Interest was aroused in these multiple dermatomyomata and by 1880 Besnier had published a comprehensive review on the subject. The *solitary* myoma cutis was also being reported by then and as some of these were painful, it came to be thought that the painful subcutaneous tubercle of Wood, the *tuberculum dolorosum* of the Continental writers, was merely a leiomyoma. Then an occasional case belonging to this clinical category was found microscopically to be a neurofibroma, and so by the first quarter of this century Wood's term fell into disrespect as being a mere carpet-bag term.

But in 1924 that coruscating histologist Pierre Masson recognized that there was another painful tumour of the skin, with a histogenesis hitherto apparently unrecognized, and a clinical picture that matched rather closely the surprising case histories given by Wood in 1812—much more so than had most of the cases of myoma and neurofibroma of the intervening years.

Masson realised that a tumour described occasionally in the past as a perithelioma or an angiosarcoma, was in fact an abnormality of the not very well known dermal arteriovenous shunt or glomus. Pathology has often fertilised Physiology, and few workers have been more promiscuous in this respect than Masson, and as a result these vascular shunts have become the object of much study. However, our interests to-day are in the pathology, and as this—the tumour of the glomal vessels, the glomangioma—is in many ways the most interesting of the dermal tumours, I propose to speak firstly and at somewhat greater length about the glomangioma. Firstly to recall the normal glomus (Popoff 1934), this is a much convoluted modified arteriole communicating directly

with a vein, by-passing the dermal capillary bed. This shunt vessel, named after its original describers, the Sucquet-Hoyer canal, has a narrow channel and a peculiarly thickened medial coat composed of large cuboidal cells, the so-called glomus cells. There is a rich perivascular nervous network. The tumour, for so I will call it for the moment, is usually single. The gross appearance varies with the site: thus the subungual form is a small cellular looking mass, not obviously angiomatous; when occurring elsewhere it is a well-defined nodule rarely over 1 cm. in diameter, situated in the lower layer of the dermis and thus not really subcutaneous, although it frequently projects downwards into the adjacent fat. Microscopically all are angiomata, with one thing in common, the so-called glomus cells; any or all of the other tissues of the normal glomus may take part in the proliferation. Of the resultant variants, one extreme form shows small vascular channels lying in sheets of glomus cells; the other is a cavernous angioma, the true nature of which is revealed only by the presence of a row, or rows, of glomus cells lying parallel with the endothelial lining of the cavities, but separated from it by a layer of connective tissue. Commonly the tumour is a mixed form, with the central part rather more cavernous and the periphery showing vessels with a small circular lumen and a broad surrounding sheet of glomus cells. The connective tissue stroma of the central zone shows varying degrees of myxomatous degeneration, occasionally an obvious neurofibromatous proliferation and in others a myomatous overgrowth. It is of particular interest that transitions are seen from the glomus cell to obvious smooth muscle cells. The glomus cell is a spheroidal cell with a circular nucleus, having an almost epithelial appearance; but special staining shows that each cell has a well defined enclosing layer of collagen. They appear histologically to be a proliferation of the specialised muscle cells that are present in the peculiar media of the Sucquet-Hoyer canal of the normal glomus. Indeed one doubts if this really is a neoplasm in the ordinary sense of the word. The further one goes in pathology the more difficult it becomes to define a simple neoplasm; this problem arises particularly with the angiomata and it has been reasonably suggested by Robertson (1939) that the term angiecton should replace angioma. Moreover, the frequency with which the onset of signs and symptoms in cases of glomangiecton is related by the patient to a single definite injury, also argues against the usual conception of a simple tumour.

Clinically the glomangiecton is usually characterized by the extraordinary pain it produces. Wood's words of 1812 are particularly true: "So strongly is this pain represented by the patients, that we might be apt to imagine their statement exaggerated, did we not find them all concurring in the same representation, and most of them willing to submit to any operation that may be necessary to remove the cause of their pain." And in 1812 that meant something. I have encountered exactly the same willingness, even an expressed desire for amputation.

Wood writes of one of his patients, " She says she does not think it possible for any person who has not experienced the pain of this disease to form any idea of its severity."

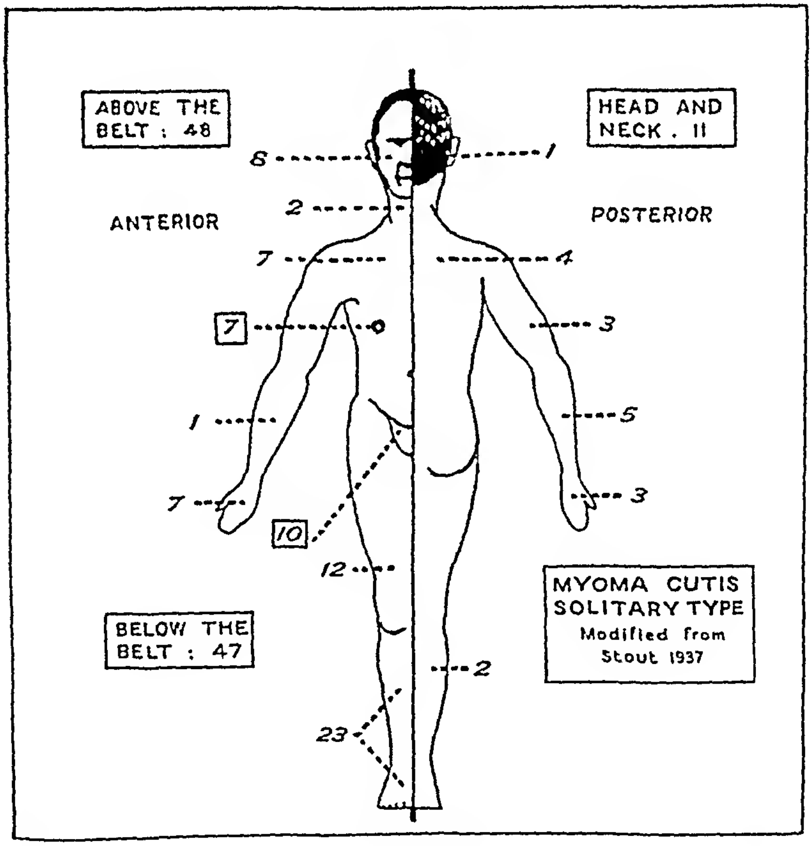
Prior to the onset of the pain a visible and palpable nodule may have been present for years—in one case 18 years. It is therefore not surprising that among painless tumours of the skin removed by surgical colleagues I should have encountered three examples of painless glomangiecton. More troublesome to patient and surgeon is the case where the pain occurs but the nodule becomes visible only after some years—in one case 12 years. Another, a woman treated over 13 years for angina pectoris finally showed a subungual tumour in the left ring finger; three years later this was removed and found to be a glomangiecton. Her " anginal " symptoms ceased completely after the excision (Blumental 1937).

In the usual case where the syndrome is established the nodule can sometimes be handled during the period between the paroxysms, but during the paroxysm it is intolerably tender. In others the nodule is sensitive to the slightest touch and the mere contact with clothes may set off a paroxysm. Temperature changes may provide the stimulus and it is of interest that some women are unduly liable to attacks during menstruation. Many of the paroxysms are spontaneous, day or night; one of Wood's cases used to wake screaming, while one of our cases (Lendrum and Mackey 1939) slept with his arm over the edge of the bed to avoid the contact of the sheets.

The pain frequently radiates, either distally or proximally and often widely; it may be accompanied by visible engorgement of the tumour and by various vasomotor upsets. One case is recorded of an associated homolateral Horner's syndrome. The attacks tend to become more frequent, more severe and of wider radiation, and the patient lives in terror of a touch. The distribution is shown in Table I and it will be noted how frequently the upper limb is affected. Table II shows that this preponderance is mainly due to the high incidence of subungual lesions in women. The clinical picture as my surgical colleague W. Arthur Mackey and I have seen it in our series of 31 cases, and as available in the modern literature, differs little if at all from the masterly description given by Wood. Because of this very complete agreement, we imagined for a time that the clinical picture was in fact diagnostic but before long we found, as did Stout in New York about the same time (Stout 1939), that this was not so, except perhaps in the case of the subungual lesion in a woman. There, if a glomangiecton syndrome is related to a nail bed, the preoperative diagnosis is virtually certain even if there be an absence of tumour, of radiological evidence of bone cupping or even of discoloration. I believe operation is justified even if a hand-lens fails to show any abnormality through the nail. Where a more or less complete glomangiecton syndrome is related to a skin nodule in sites other than the nail bed the lesion may be a glomangiecton, a myoma, a cavernous angiecton, a neurofibroma or rarely practically anything else e.g. fibro-

sarcoma, keloid, secondary carcinoma (Stout 1939). Despite this ambiguity the surgical indications are clear—in the words of Wood, " The disease luckily admits of a safe and simple remedy, namely extirpation by the knife " and extirpation it should be. Too many of these cases have been unsuccessfully treated by casual and vaguely optimistic incision.

Myoma of the skin, myoma cutis occurs in two forms; it is not clear what the essential difference really is between the solitary and the multiple forms, although the latter are practically all from the arrectores pilorum muscles whereas the solitary forms are rarely of this histogenesis. The diagram modified from Stout, shows the distribution of the 95 then available solitary tumours, including Stout's own series of 15 cases. The incidence in the nipple and the pudendal regions is of interest: these arise from the muscularis sexualis.



Distribution of solitary type of myoma cutis, as given by Stout (1937).

Prior to Stout's paper (1937) no observer had reported more than five cases; this is strange because at the Western Infirmary since 1939 my colleagues and I have seen 17 clear-cut examples. I therefore feel justified in echoing Stout when he claims that this is not so rare a tumour. Like

the usual glomangiecton it is a solid small nodule arising in the deep layer of the dermis, frequently projecting into the subcutaneous fat and well circumscribed. Of Stout's 15 examples, eleven showed, as did 15 of ours, an architecture that suggests a foundation on abnormal blood vessels. This is particularly obvious in the central part of the nodule where there are many of these vessels, and higher magnification shows that the muscular tissue of such vessels is continuous with that of the surrounding "tumour." Clinically this muscular haemangiecton can behave exactly like a glomangiecton, although a subungual form has never been described. The type arising from hair muscle is an ill-defined intradermal growth, sometimes of considerable size.

Another skin tumour which clinically mimics the glomangiecton is the cavernous haemangiecton. Having been brought up on the hepatic cavernous angioma it was rather a shock when I first found that so placid-looking a tumour could be productive of such pain. There seems nothing in the histology even at high powers to suggest such potentialities. Since then I have seen three tumours of this type in the cerebral cortex all of which appeared to have been the cause of death ; in one which led to death in convulsions some five hours after onset there was evidence of slight softening in the adjacent cerebral tissue but nothing else to explain the mechanism. I therefore regard the cavernous haemangiecton with new respect even if without new understanding.

All the other tumours of skin, including even the neurofibroma, only very rarely mimic the glomangiecton syndrome, thus I think we are justified in relating the syndrome essentially to an abnormality of blood vessels, but since smooth muscle is not present in the cavernous angiecton, one cannot justifiably relate the pain, as some have done, to the presence of smooth muscle in these so-called tumours. Further, the neural content of these nodules is often so slight that one can scarcely attribute the pain to that. None the less it is very tempting to group together on clinical grounds these abnormalities of blood vessels, the glomangiecton, the myoangiecton (solitary myoma cutis) and the cavernous haemangiecton, and to point out that the pain in these cases is somewhat of the type which Leriche (1939) attributes to disturbance of the sympathetic neurovascular mechanism.

From the practical point of view, many of the features worth recalling are generally applicable to the group. The nodule may be present for years before causing symptoms but once begun these symptoms may quickly attain great severity—so much so indeed, that one tends to discredit the patient's story, and far too many of these wretched people have been fobbed off with an aspirin and a kind word. More important still is the fact that in both glomal and myal forms, the nodule may not be evident at the time of onset of symptoms, nor for long after—in one glomal case it was 13 years, in one myal case nine years before the nodule appeared to explain the symptoms. In several of these, the patient could indicate the trigger point even though nothing was to be seen or felt.

The glomangiecton particularly if subungual may be of minute size. Finally all these lesions are in fact *cutaneous* lesions and therefore some corium has to be sacrificed if the removal is to be complete. Few simple operations can give so general satisfaction as the extirpation of these small vascular abnormalities.

Of other painful skin tumours, many may be recognised on the history, but there is one, however, in which the history may be difficult to unearth; this is the comparatively rare fibrous granuloma arising at the site of an earlier traumatic implantation of silica. The implantation can sometimes be traced to a fall in which some tiny fragments of gravel become embedded in the skin usually of the nose or forehead. Eventually, after a lengthy latent period there forms a nodule at the site, histologically a giant-cell follicular lesion, very suggestive of proliferative tubercle, hence the usual term for this lesion, pseudotuberculoma silicoticum. One recently observed example developed within a few months on the forehead of a woman, after the unusually long latent period of 45 years. When the histological section of such a lesion is examined by polarised light the acicular silicious fragments, contained usually within giant cells, show characteristic double refraction. The rather more commonly encountered type of silicious granuloma is that arising in an abdominal wall scar (from the talc of the surgeon's glove); this is so obviously within the scar that its nature should be immediately evident to the observer. The pain of this lesion may be sufficient to demand excision of the scar, and it is a wise precaution to omit the use of talc in this operation. The silicious granulomata in general have assumed a new interest for us in Glasgow through the discovery by Dr. G. B. S. Roberts in our department of a series of silicious granulomata in the Fallopian tube. This is indeed a far cry from tumours of the skin but like the silicious granulomata of scars, these lesions can be attributed to previous surgical operations; in every case there had been a previous laparotomy, usually for simple appendicectomy. The disruption of the structure of the tube is only too evidently related to the sterility which afflicted these cases and since I have the pleasure of speaking to you as surgeons I make no excuse for commending this work very strongly to your notice.

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TABLE I

SITUATION OF GLOMANGIOMATA

	a	b	c	d	Total
UPPER EXTREMITY	53	80	13	16	162
including Hand	13	19	3	7	42
and Subungual	22	29	6	3	60
LOWER EXTREMITY	18	31	2	7	58
ELSEWHERE	5	14	1	4	24
Total	76	125	16	27	244

a : Lee 1938 collected cases, *b* : Kirshbaum et al 1939 collected cases, *c* : Stout 1935 own cases, *d* : author's own cases.

TABLE II

SEX DISTRIBUTION OF SUBUNGUAL GLOMANGIOMATA

	Males	Females
Lee's collected cases..	1 in 30	17 in 34
Stout's own cases	0 in 7	6 in 9
Author's own cases	0 in 18	3 in 7
Total ..	1 in 55	26 in 50

THE SURGICAL ASPECTS OF INTESTINAL AMŒBIASIS

Hunterian Lecture delivered at
The Royal College of Surgeons of England
on
5th June, 1947

By

Professor R. W. Nevin, F.R.C.S.,
Assistant Surgeon to St. Thomas's Hospital

INTRODUCTION

SINCE THE notice of this lecture first appeared, I have been frequently told that surgery plays no part in intestinal amœbiasis. This is partly true. Operative procedures are seldom necessary and are usually very definitely contra-indicated.

The importance of intestinal amœbiasis to the surgeon is that the condition may simulate almost any abdominal lesion and if operation is carried out in unrecognized and unsuspected cases, the mortality is very high.

Surgical incisions in these cases heal with difficulty and may become the site of an ulcerative process.

In fact, it has been said that this condition is one with a surgical diagnosis and a medical treatment.

The large number of service personnel who have served in countries where amœbiasis is endemic and have now returned, make this subject of great practical importance.

This lecture is based on personal clinical experience, first during four years' military service in Persia, Iraq, Egypt, Malta and Italy, where amœbiasis is common and secondly, in cases seen since returning to civil practice eighteen months ago: these latter cases have mostly been in demobilized service personnel.

The title of the lecture, " The Surgical Aspects of Intestinal Amœbiasis " is intended to exclude hepatitis, hepatic abscess and the pleuro-pulmonary and cerebral cases.

PATHOLOGY

A review of the pathology of the condition will be helpful in the consideration of the subject. Entamœba histolytica passes through the mucous membrane of the large intestine into the submucous tissue and then produces an inflammatory reaction with œdema but remarkably little leucocytic infiltration.

The centre of the swollen and congested patch, so formed beneath the mucous membrane, typically becomes soft and yellowish as necrosis occurs in its centre. The mucous membrane gives way in the centre and forms an ulcer which has a necrotic floor and shreddy undermined margins.

They have been described as bottle-neck or button-hole ulcers on account of the relatively large area of destruction in the submucous space as compared with the actual size of the loss of mucous membrane.

These ulcers may appear as mere pin points or the process may spread in the submucous space and contiguous lesions may become confluent, forming sinuses and eventually large areas of mucous membrane may slough. The ulcers usually extend in the longitudinal axis of the bowel. The larger ulcers have thickened edges, which are considerably raised from the surface of the mucous membrane and are much undermined. The floor of the more recent ulcers is covered with necrotic material, blood and pus. The more chronic ones show a smooth floor.

Histological sections of early and acute cases show that the characteristic lesion is produced by an actual lysis of tissue by the entamœba. There is remarkably little tissue reaction. This only occurs later when secondary bacterial infection is superadded.

The muscular coats of the bowel may become involved and perforation may occur. When this process occurs, it usually happens gradually so that adhesion to omentum or surrounding structures occurs before the actual perforation takes place. This means that a localized pericolitis or periproctitis with or without abscess formation is much more common than a free perforation into the peritoneal cavity.

The lesions may be scattered throughout the large bowel, but are frequently confined to the cæcal or to the rectosigmoid regions as these tables show.

Amœbic Lesions and Different Bowel Levels[1]

New Orleans Hospitals

Analysis of 249 Autopsies on Cases of Amœbiasis

Ileum	5·6%	
Ileo-Cæcal Valve	2·4%	67·8%
Cæcum	33·3%	
Appendix	32·1%	
Ascending Colon and Hepatic Flexure	8·4%	
Transverse Colon	4·4%	
Splenic Flexure and Descending Colon	6·4%	
Sigmoid Colon	12·4%	28·1%
Rectum	15·7%	

POST-MORTEM FINDINGS IN ELEVEN CARRIERS OF ENTAMŒBA HYSTOLITICA (BARTLETT)[2]

Case No.	Cause of Admission	Causes of Death	Post-Mortem Findings in Intestine (Author Quoted)
10	Gunshot wound of chest	Empyema Proncho-pneumonia	"Very widespread early acute discrete amœbic ulceration in colon; confluent ulceration in cæcum"
12	Gunshot wound of abdomen	General peritonitis	"A few isolated amœbic ulcers in descending colon and rectum"
16	Gunshot wound of head	Angina pectoris. Coronary thrombosis	"A few isolated amœbic ulcers in cæcum and sigmoid colon"
29	Hepatic insufficiency	Broncho-pneumonia. Cirrhosis of liver	"Five large transverse amœbic ulcers and a few 'bouton de chemise' ulcers in sigmoid"
31	Diabetes	Bronco-pneumonia. Diabetes	"Rounded and transverse amœbic ulcers in sigmoid colon"
36	Lobar pneumonia	Lobar pneumonia	"Group of rounded and transverse granulating ulcers in sigmoid colon"
42	Gunshot wound of buttock	Septicæmia	"Isolated amœbic ulcers of various size throughout colon, some confluent in cæcum and ascending colon"
50	Gunshot wound of feet	Pyemia	"Sparsely scattered nodules, 'bouton de chemise' ulcers, and transverse ulcers in cæcum and ascending colon. Some ulcers through to peritoneum and nearly perforated"
52	Gunshot wound of chest	Septicæmia and empyema	"A few 'bouton de chemise' ulcers in cæcum; two large transverse ulcers in ascending colon; group of scarring ulcers in rectum"
57	Subacute meningitis	Hydrocephalus	"A few isolated rounded and transverse granulating ulcers in lower colon and rectum"
59	Frost bite	Broncho-pneumonia	"A few small rounded granulating amœbic ulcers in cæcum"

The first is an analysis of 249 post-mortem examinations on cases of amœbiasis carried out in hospitals in New Orleans.

The second are Bartlett's statistics of eleven cases, which came to post-mortem examination on account of conditions other than amœbiasis and who had never had any intestinal symptoms.

It will be seen that gross lesions may be present in carriers of the disease, who have no symptoms at all. Craig[3], in seventy-eight fatal cases of amœbic dysentery, found that in fifty-seven cases lesions were present in the cæcum and Recto-sigmoid regions; in twelve cases the entire length of the large intestine was involved and in nine cases there were active lesions in the Recto-sigmoid region with healed lesions in the cæcum.

Clark's[4] post-mortem investigations showed that in 61 per cent. of cases the lesions involved the whole of the large intestine and that 34 per cent. were localized to isolated areas in the large bowel in the following order of frequency: cæcum, ascending colon, rectum, sigmoid, appendix, splenic flexure, hepatic flexure. Cases with lesions confined to the cæcum are more likely to be latent and less likely to cause dysenteric symptoms than those with lesions lower down the bowel. In chronic cases, an inevitable superadded bacterial inflammation occurs, which is associated with a polymorph reaction and the formation of fibrous tissue. Strictures are produced in this way and may give rise to a saccular appearance of the cæcum and ascending colon, but rarely cause obstruction or other symptoms except when they occur in the rectum.

A less usual manifestation of the infection in the bowel is the formation of a granuloma. This is most commonly found either in the cæcum or in the Recto-sigmoid region. This hypertrophic lesion chiefly affects the sub-mucosa and consists of round-celled infiltration with lymphoid hyperplasia and a number of histiocytes and eosinophiles.

Both a granuloma and an individual ulcer in the cæcum have been known to form the apex of an intussusception.

DIAGNOSIS

Desjardins has made the remark that experience in diagnosis of amœbiasis determines the difference between surgical resection or medical treatment.

The possibility of amœbiasis must always be considered in the diagnosis of any unusual abdominal condition in a patient, who is at all likely to have acquired the disease even if no actual dysenteric symptoms are present. It is convenient to consider these abdominal conditions in three groups.

I. Actual surgical complications of amœbiasis, which we shall consider in some detail later.

II. Amœbiasis simulating other conditions such as: Appendicitis, the Dyspepsias, Intestinal occlusion, Gall stones and Renal stones.

III. Amœbiasis complicating the natural recovery from surgery as in the infection and ulceration of wounds in cases of Appendicectomy and the ligature and excision of hæmorrhoids.

Individuals with chronic or latent amœbiasis will be generally below par, will usually have a secondary anæmia and appear to be in chronic ill health.

Some authorities state that the majority of persons infected with entamœba histolytica do not have dysenteric symptoms. Dysentery is, in fact, only one manifestation of the disease. Many cases present themselves with vague abdominal symptoms and give no history of dysentery at all.

Sapero J. J.[5] states that of a series of 46 patients with non-dysenteric intestinal amœbiasis, 84.8 per cent. presented with abdominal pain and 63 per cent. had tenderness in the neighbourhood of McBurney's point. It is clear that non-dysenteric amœbiasis presents the major diagnostic problem. A patient presenting with dysentery would certainly be suspected of amœbiasis and entamœba hystolitica in some form would be recognized in the stools. The absolute diagnosis does and must rest on the demonstration of the amœba.

In those cases which present with vague abdominal pain or with definite symptoms and signs localized to the right lower quadrant of the abdomen, a saline purge will frequently cause cysts of the amœba to appear in the stools. A provocative dose of emetine may do the same. These two methods have come to be used because clinical observation has shown that a latent amœbiasis has frequently been brought to light by an attack of enteritis or bacillary dysentery *and also* if frequent examinations of the stools are made in patients, who are receiving a course of emetine as a therapeutic test, the amœba is quite commonly demonstrated.

Sigmoidoscopy

In about one-third of all cases of amœbiasis there are demonstrable lesions in the rectum or lower sigmoid colon which can be seen with a sigmoidoscope. Four main types of lesion may be recognized :—

I. The frank large ulcer which may be diamond shaped and may be single or multiple and if single or few usually shows a fairly normal mucosa apart from the actual lesions. These ulcers have a raised and ragged margin with overhanging edges and a slough is visible in the floor. Usually the amœba will have been readily demonstrated in the stools of these cases without any difficulty, but if not a specimen of the slough from the floor of one of the ulcers should be examined.

II. The pin point lesion, which is so often seen on one of the valves of Houston, consists of a raised red area with a greyish white centre. These are often few in number and may be missed unless carefully looked for.

Their centres should be scraped with a sharp instrument and examined for the amœba. Often in these cases the stool examination will have been negative.

III. " Crateriform Pits " are recognizable in old and quiescent cases of amœbiasis, though the non-activity may only be local. There may be active lesions higher up in the bowel. They consist of small circular depressions about two millimetres in diameter, whose edges are raised up from the surrounding mucosa. It is not usually possible to demonstrate the amœba in scrapings from these.

IV. The amœbic granuloma, which usually has an ulcerated surface, is easily confused with a carcinoma. In the cases that I have seen they have been less friable than a carcinoma. A biopsy and a smear should be taken.

The method of collection and examination of the specimens for amœbæ taken at sigmoidoscopy is important. A small sharp spoon with a suitably long handle to be introduced into the sigmoidoscope is the best instrument to collect the specimen, which should consist of the actual slough or secretions from the floor of the ulcer. This should be put directly upon a warmed microscope slide and mixed with a little warm saline and a cover-slip should be placed in position and the slide examined as soon as possible. In clinics abroad, it was a great advantage to have a pathologist in attendance in the sigmoidoscopy room when one was doing a number of examinations.

The value of the white cell count in diagnosis is not really very great. A leucocytosis to 10-20,000 is usual with about 70 per cent. polymorphonuclear cells. There may be a slight increase in eosinophiles but this is not a constant finding. The degree of leucocytosis will vary with the extent of any secondary infection that may be present.

The Value of Radiology in Diagnosis

The accepted and standard text books both in this country and America agree that there are no radiographic changes which make an accurate differential diagnosis of amœbiasis possible. They point out that the diagnosis rests securely on the demonstration of the entamœba, but that radiographic examination serves to indicate the degree and distribution of pathological changes. The actual findings on Barium Enema and on Barium meal in cæcal lesions are those of any chronic inflammatory lesion which has progressed to cause some narrowing and deformity of the gut. The only fundamental distinction between amœbiasis and chronic ulcerative colitis is the tendency in the former for the lesions to be confined to the cæcal region or some other part of the large bowel, whereas chronic ulcerative colitis is more diffuse in its distribution. Two recent studies of this subject are of some value.

Druchmann and Schon[7], of the Hardassa University in Jerusalem, divide the manifestations of amœbiasis in the large intestine into two types. One, the diffuse type, which is not characteristic on X-ray examination and resembles idiopathic or ulcerative colitis. Two, the localized type, which presents a more characteristic picture. These lesions occur, in order of frequency, in the cæcum, ascending colon, sigmoid colon and rectum. They notice the following radiographic differences between these lesions and carcinoma. (1) The filling defect is relatively long in its extent. (2) The lesions are often multiple. Carcinomata may be multiple but very rarely so. (3) The incompleteness of the narrowing as compared with malignant stenosis. Acute intestinal obstruction is rare. (4) The pain which is so typically produced by distension of the stricture by Barium in carcinoma is much less or even absent in this condition. The stricture is less rigid. (5) Frequently, the abnormal area merges very gradually into the normal in this condition. (6) The elasticity of the intestinal wall remains in part and distension of the lumen can be demonstrated on the introduction of Barium. (7) The mucosal relief of the

involved portion of the bowel is more or less normal. This emphasizes again the fact that the submucosa is the tissue essentially affected in this condition. (8) The therapeutic test—more or less complete restoration to normal after appropriate specific treatment.

Golden and Duchame[8], of Columbia University, New York, studied the clinical significance of deformity of the cæcum in amœbiasis and found that a Barium meal gave a more helpful picture than a Barium Enema.

A group of 119 cases of proved or suspected amœbiasis were studied. 107 had entamœba histolytica in their stools. Sixty-seven of the 119 had a Barium examination and there was a cæcal deformity in 30 cases. Twenty-one of these 30 cases had proved amœbiasis and the disease was not disproved in the other nine cases. Of the 58 patients who had amœbæ in the stools, 21 (*i.e.* 36 per cent.) had a deformity of the cæcum; 33 (*i.e.* 57 per cent.) had no deformity; 4 (*i.e.* 7 per cent.) had deformities distal to the cæcum. The deformity observed was a shortening and narrowing of the cæcum and a patency of the ileo-cæcal valve. Golden and Duchame point out that the differential diagnosis from tuberculosis is that in the latter the terminal ileum is usually involved. It is stated that only in five per cent. of cases of tuberculosis of the cæcum is there no ileal involvement. Regional enteritis most commonly affects the ileum only. Carcinoma produces an irregular and asymmetrical filling defect with a palpable mass.

If all other methods of diagnosis have proved uncertain, that is really if one has failed to demonstrate the amœba by any means and one still suspects amœbiasis, the therapeutic test should be applied. A course of emetine is given and its effect is observed. As already mentioned, this may give absolute proof by producing the amœba in the stool or if the symptoms and signs are relieved, the circumstantial evidence may be very strong.

CLASSIFICATION OF COMPLICATIONS AND SEQUELÆ OF INTESTINAL AMŒBIASIS WHICH ARE OF SURGICAL INTEREST

1. Appendicitis.
2. Ulcerative processes, including those extending beyond the wall of the bowel and similar processes affecting operation wounds in the anal canal, etc.
3. Perforation.
4. Pericolitis and pericolic abscess.
5. Fistula.
6. Massive hæmorrhage.
7. Stricture.
8. Granuloma.
9. Hæmorrhoids.

Appendicitis

We have seen that the cæcal region is the commonest site for the chronic and subacute manifestations of amœbiasis. The appendix may

be affected by the entamœba hystolitica in exactly the same way as the cæcum. Clinical observation seems to show that amœbiasis does not, as a rule, lead to stricture formation in the appendix and so predispose to attacks of obstructive appendicitis. On the other hand, the œdema and general inflammatory reaction produced by an amœbic infection may precipitate an acute exacerbation in a previously diseased appendix.

Cases which present with an inflammatory mass in the right iliac fossa and are treated by the Ochsner-Sherren method can be divided clinically into two types : (i) those which resolve readily, as the ordinary " appendix mass " will do, and (ii) those which fail to improve and rather tend to linger and eventually may be shown to clear up when treated with emetine. For completeness, perhaps, the more chronic inflammatory masses in the right iliac fossa such as tuberculosis should be mentioned. Those cases which go on to frank abscess formation require drainage in either case.

The dangers of leaving a case of acute obstructive appendicitis in which there is no clinical evidence of localization are well recognized. There are very considerable dangers and difficulties in removing the appendix in cases of acute amœbiasis involving the cæcum and appendix. The tissues are œdematous and friable and any stitch will tear out. A ligature may hold, but satisfactory closure of the stump of the appendix is impossible. I have removed the appendix on one occasion from a patient in this state. A ligature appeared to hold fairly well on the appendix stump. No attempt was made at invagination and a soft rubber drain was placed down to the ligature for forty-eight hours and then gradually withdrawn. The appropriate medical treatment was instituted at once and the patient made an uneventful recovery.

Many deaths have been recorded following appendicectomy for acute infections of the appendix in amœbiasis. The death rate was appallingly high in the famous Chicago epidemic in America in 1933. The deaths were due to fæcal peritonitis and wound infections. If operation is undertaken in these circumstances, the most important thing is that the nature of the condition should be recognized and the appropriate specific anti-amœbic treatment instituted.

K. L. James[9], in his very valuable communication to the Section of Proctology of the Royal Society of Medicine last year, suggested that when the abdomen is opened and the cæcum and appendix are found to be involved in the same process and the condition is thought to be one of amœbic infection, the appendix should not be removed and that the tissues should be most carefully handled and, at the most, a soft corrugated drain should be inserted for seventy-two hours.

It may be emphasized again that the greatest danger is to operate upon a case of amœbiasis and to fail to recognize the condition and to institute the appropriate medical treatment. Appendicitis may present in an acute or chronic form. The differential diagnosis in acute cases may be very difficult. The greatest help in diagnosis, as in so many abdominal conditions, is a careful and accurate history. The pain in acute appendicitis

will start in the epigastrium or centrally. The pain in amœbiasis of the cæcal region usually starts in the lower abdomen, when the patient often describes it as going across the lower abdomen, or in the right iliac fossa. Acute appendicitis tends to occur in a person who was previously fit although he may have had previous attacks of a similar condition, whereas the symptoms of amœbiasis often present in a person who has been below par for some considerable time. If the case is seen early both history and physical signs may help in the differential diagnosis. In the established case, the physical signs will probably be identical. In the chronic forms of the disease, again an accurate history of recurring attacks of pain may help to distinguish appendicitis from amœbiasis, which most typically presents as a thickening or mass, which does not clear up on rest. The best procedure in the doubtful case is to operate, only when there are signs of an unlocalized acute inflammatory process or when emetine has failed. This case of a young soldier of twenty-three illustrates a number of points and serves an example of amœbic Typhlitis, Massive Hæmorrhage, Granuloma, and acute intestinal obstruction.

J.H.G. *Age*: 23 *IRAQ.*

Admitted to Hospital on September 1, 1942.

History.—Abroad five months—Capetown, Bombay, Iraq. While on board ship off Capetown five months ago, was awakened with severe pain across the lower abdomen which radiated to the right loin and settled there. He had no diarrhœa and his symptoms settled completely in twenty-four hours. Two days before admission, pain recurred across the lower abdomen.

State on Admission.—T.P.R.: Normal. Indefinite thickening and tenderness in the right iliac fossa. Blood and mucus present in stools. Stools negative for amœbæ and dysenteric bacilli. Mass in R.I.F. became more definite, blood and mucus ceased. Repeated examination of stools normal.

White Cell Counts:	*September* 3, 1942	*September* 18, 1942
W.B.cs.	20,000	18,800
Polys.	71%	79%
Small Lymphs. ..	20%	17%
Large Monos. ..	9%	3%
Eosins.	0%	1%

September 29, 1942.—C/O pain in back: Runs intermittent fever. T.100-2, P. 110, R. 20. Mass persists.

October 9, 1942.—Condition deteriorating. Massive Hæmorrhage.

October 12, 1942.—Sigmoidoscopy: Granuloma present at 8 in. Typical diamond-shaped ulcers seen with ragged edges. Entamœba hystolitica demonstrated in scrapings. Course of Emetine commenced. Blood transfusion (one pint) given.

October 15, 1942.—Much improved.

October 30, 1942.—Sigmoidoscopy: Granuloma almost disappeared.

November 10, 1942.—Developed typical acute attack of small bowel obstruction.

Operation.—Cause of obstruction was a thick œdematous band in the right iliac fossa. This was divided. After operation, improved slowly.

December 21, 1942.—Further course of Emetine and Amibarsone.

January 18, 1943.—No exudate, amœbæ or cysts in six successive stools.

February 4, 1943.—Evacuated to U.K. Fit.

Ulcerative processes, including those extending beyond the wall of the bowel and similar processes affecting operation wounds.

It may be said that all the surgical complications of the condition are associated with an extension of the ulcerative process, which is usually associated with a secondary infection. The best illustrative case of this condition is one which was admitted to St. Mark's Hospital under the care of Mr. W. B. Gabriel, when I was his house surgeon. It has been reported in the literature[10] and photographs have been published. The patient was a man of thirty-five who was admitted to hospital in April, 1938. He had served in the army as a cook from 1922 to 1928 in India, Mesopotamia, Malta and China. He was not ill during his service and he stated that he had never had any dysenteric symptoms. Three years before his admission to St. Mark's, he developed an abscess in his anal region, which burst and continued to discharge for two and a half years. In January, 1938, he was admitted to another hospital and was found to have a stricture, which just admitted the tip of the finger, three inches above the anus, with friable ulceration below it, which bled freely when touched; there was no induration suggesting a growth. A left iliac colostomy was performed, but in spite of irrigations, the rectal discharge became worse. The ulcerative process spread over the perineum and also appeared and spread around the colostomy. On admission to St. Mark's Hospital, the patient was extremely ill, emaciated and anæmic and was running a swinging temperature. Biopsy fragments from the margins of the ulcerated area showed an intense infiltration of the tissues with inflammatory cells but no evidence of Tuberculosis or Neoplasm. No pathogenic protozoa or cysts were found on examination of the fæces or of scrapings from the ulcerated areas. It was considered that some infective process which originated in the bowel itself must be the cause of this gross ulcerative process affecting two sites at which the bowel reached the body surface, the anus and the anterior abdominal wall at the position of the colostomy. A course of emetine was given with dramatic improvement and also with the appearance of the cysts of entamœba hystolitica nine days later. After a course of emetine bismuth iodide and yatrin, all the sloughs had separated and a clean granulating surface remained.

After the removal of a necrotic coccyx, this granulating surface was grafted with Thiersch grafts and the patient made an excellent recovery. The colostomy had to be permanent because the anal musculature had sloughed away completely.

Two of my own cases of hæmorrhoidectomy in Iraq are very instructive.

T.H. *Age*: 25 *IRAQ*

Admitted to Hospital on September 17, 1942.

History.—Hæmorrhoids for five years, prolapsing recently. Had an attack of diarrhœa for three days in India, but no dysentery was proved.

State on Admission.—Large third degree hæmorrhoids. Sigmoidoscopy: Normal.

September 19, 1942.—Operation. Ligature and excision of three primary hæmorrhoids. At first post operative course was normal.

October 19, 1942.—Anal wounds not healed, infection and excessive granulation tissue present.

October 26, 1942.—Wounds increasing in size.

November 1, 1942.—After repeated examination, cysts of entamœba hystolitica found in stool. Course of emetine given.

November 9, 1942.—Wounds clean.

November 16, 1942.—Wounds healing rapidly.

December 17, 1942.—Discharged: Healed.

N.O. *Age*: 30 *IRAQ.*

Admitted to Hospital on September 11, 1942.

History.—Seven years history of attacks of rectal bleeding, recently associated with prolapse. Three months ago was investigated for diarrhœa in India. No evidence of dysentery was found.

State on Admission.—Large third degree hæmorrhoids.

September 14, 1942.—Operation. Ligature and excision of three primary hæmorrhoids.

October 12, 1942.—Anal wounds increasing in size and grossly septic.

November 2, 1942.—Local condition getting worse. Repeated examinations for entamœba hystolitica negative. Course of Emetine given as therapeutic test.

December 9, 1942.—Cysts of entamœba hystolitica found in stools.

January 25, 1943.—Discharged to duty: fit.

Amœbic ulceration of the skin and subcutaneous tissues is not a common manifestation and when it occurs it usually appears around the anus or around a colostomy or a wound made for the drainage of an amœbic abscess. A primary cutaneous lesion has been described but is excessively rare. The clinical manifestation of these cutaneous lesions is that of a progressive irregular ulcer with overhanging gangrenous edges, surrounding these edges is a pigmented zone, which has been described

as a " halo " of a dusky reddish colour which gradually merges into the normal skin. The floor of the ulcer consists of adherent greyish necrotic tissue and the discharge is fetid and often gangrenous. Amœbæ are not usually present in the exudate but can often be demonstrated in the tissues beneath the undermined edges of the ulcer. It will be seen that the condition approximates to that of a spreading gangrene of the skin. The prognosis is grave and in one series of twenty-six cases reviewed by Wyatt and Buchholz[11], the mortality was 42·3 per cent.

Perforation

Perforation may occur after adhesions have occurred between the site of perforation and the omentum or a neighbouring viscus or it may occur into the free peritoneal cavity. In either event, it will occur in a case of gross and active amœbiasis and in a very ill subject. The most common sites are in the cæcal and the recto-sigmoid regions. It is only when there is a fæcal flooding into the general peritoneal cavity that a dramatic change will be noted in the physical condition of the patient. There is then collapse, rising pulse-rate, distension and abdominal wall rigidity. The more usual condition is that of a perforation into some confined space where adhesions have previously formed. This will produce an increase in local symptoms and signs and will result in a pericolitis or pericolic abscess.

In 1944, Tan and Liu[12] studied twenty cases of autopsy on cases of amœbic dysentery with special reference to perforation. They all occurred in fulminating acute cases. It is doubtful whether laparotomy is ever justified in cases of perforation. It is clearly only indicated in those of free perforation. These patients are always in extremely poor condition and it is very difficult to effect a closure of the perforation on account of the fragility of the tissues. However, there are two cases of successful suture on record.

Pericolitis and Pericolic Abscess

Pericolitis and Pericolic Abscess should be treated expectantly with anti-amœbic drugs in the first instance. Later, the abscess may be aspirated or may be drained on the same principles as any other intra-peritoneal abscess if necessary. Anti-amœbic treatment should be continued.

Fistula

Fistula may occur as a result of perforation or spread of infection in the perianal region. The condition may be associated with gross perianal ulceration as already described. It is important to recognize the amœbic nature of the lesion, apply the specific treatment and then deal with the fistula by the ordinary surgical measures appropriate to its particular anatomy.

Massive Hæmorrhage

Massive Hæmorrhage may occur in any case of active amœbiasis, but most typically happens when there is gross secondary infection with the formation of sloughs. The separation of these is often associated with gross bleeding. As in all other complications of the disease, its prompt recognition and the prompt administration of specific drugs is the most important thing. Sedatives and blood transfusion should be given as required.

Stricture

Fibrous stricture results from deep ulceration with secondary infection and is most common in patients who have had recurrent infections over long periods. As already pointed out, these lesions are most common in those areas of the large bowel most usually affected by the disease.

Sacculation of the cæcum and ascending colon rarely give rise to any symptoms because of the fluid nature of the intestinal contents at this level and the fact that these strictures are seldom marked. Strictures of the rectum usually occur within reach of the finger and often will only admit the tip of the little finger and are diaphragmatic in their arrangement. They almost certainly follow gross ulceration with secondary infection. Typical amœbic ulcers are frequently seen with the proctoscope or the sigmoidoscope in these cases.

The correct treatment is to give anti-amœbic drugs first, which are not likely to have any effect upon the fibrous stricture, but it is very dangerous to carry out any surgical procedure until this has been done. Systematic and repeated dilation with posterior proctotomy, when necessary, are then carried out.

One unusual personal case of amœbic stricture may be recorded:—
An R.A.M.C. officer was invalided home early in the war with a diagnosis of carcinoma of the transverse colon. He had noticed that his cæcum became very distended at times and a barium enema demonstrated a stricture in the transverse colon. He had had very severe Amœbic Dysentery in the Khyber Pass in 1919 and had been very ill indeed. Otherwise, he had been a fit man. At laparotomy two fibrous strictures were found in the transverse colon. They seemed to be caused mainly by a pericolic fibrosis and almost certainly represented the result of small perforations with secondary infection. It was possible to carry out plastic procedures without actually opening the lumen of the bowel and the patient made an excellent recovery and has remained well since.

Granuloma

This is not a common manifestation of the disease but is extremely confusing from the point of view of diagnosis. It is very easily confused with carcinoma. The most common situations are the cæcal and the recto-sigmoid regions. A mass is felt and a partial or complete obstruction may be present. Mistakes are frequently made in diagnosis unless the

condition is kept in mind. The entamœba may be demonstrated in the stools or a typical lesion may be seen with the sigmoidoscope. On treatment with emetine, the granuloma usually disappears dramatically leaving very little scar tissue. The therapeutic test is therefore very helpful. The ultimate difficulty in diagnosis rests in the fact that a granuloma and a carcinoma may exist together in the same patient and at the same time.

The following cases serve to illustrate the problems involved:— Gunn and Howard[13] reported three cases in 1931 in which the diagnosis of carcinoma was made, one was situated in the cæcum, one in the transverse colon and one in the descending colon. Resection was carried out in all the cases. They all proved to be amœbic granuloma and two of them died as a result of operation.

Yeomans[14] in 1936 described a case of amœbic granuloma of the rectum and another simulating carcinoma of the colon. He emphasizes that radical treatment by surgery is almost invariably fatal unless anti-amœbic treatment has been given.

Cameron and Collins[15] in 1942 reported a case of a corporal aged twenty-seven who presented with acute intestinal obstruction and had one tumour in the rectum and one in the transverse colon. The condition was not suspected of being amœbic. A cæcostomy was performed, which relieved the obstruction, but a fungating mass appeared at the opening. Emetine was then given empirically and all the lesions cleared up dramatically.

Lindskog and Walters[16] in 1946 described a case of a patient aged twenty-seven, who had had an acute attack of amœbic dysentery in September, 1944. In April, 1945, a recurrence failed to respond to treatment and the patient had a tumour on the right side with increasing anæmia. A right hemicolectomy was performed after previous anti-amœbic treatment, the patient made an uninterrupted recovery. The specimen showed a chronic granuloma of the ileo-cæcal junction with small superficial ulcers of the ascending colon.

My personal cases are more ordinary but instructive.

In one, a young soldier who presented with a mass in the right iliac fossa, which was discrete and slightly tender and who had entamœba hystolitica in his stools, the lesions cleared up on emetine.

The other case was a woman of forty-six, who was seen in Out-Patients in London and who had never been out of England. She gave a history typical of carcinoma of the rectum and on examination with a finger there was a firm fixed mass in the upper third of the rectum. Proctoscopy and sigmoidoscopy revealed no ulcers or abnormalities other than the palpable lesion, which was ulcerated and protruded into the lumen of the rectum and involved about two-thirds of its circumference. A clinical diagnosis of carcinoma of the rectum was made and a specimen taken for biopsy was returned as granulation tissue. A further biopsy confirmed this. The stools were searched for amœbæ which were found. The mass disappeared completely on a course of emetine.

The chief point in this most important differential diagnosis is that the possibility of an amœbic granuloma should be kept in mind even in people, who have not lived in the so-called endemic areas.

The usual methods of establishing or excluding a diagnosis of amœbiasis are used. If the therapeutic test has failed in a suspected case, resection may be undertaken, with the giving of further anti-amœbic drugs. This procedure will act as a safeguard in those rare cases where carcinoma and amœbic granuloma co-exist and those rare cases in which an amœbic granuloma does not disappear completely and readily with anti-amœbic drugs.

Hæmorrhoids

Hæmorrhoids frequently appear or become acutely inflamed as a result of an acute attack of dysentery. It is important to recognize the sequence of events in such cases and treat the dysentery. The hæmorrhoids will then subside.

Two cases have already been described of gross prolapsing hæmorrhoids in patients with latent amœbiasis. It was seen that the operation wounds became ulcerated and failed to heal until the true nature of the condition was recognized. The Amœbiasis should first be treated and then any hæmorrhoids that persist may be treated surgically on their merits.

Treatment

It has been seen that in most instances the only treatment required is medical : the giving of the appropriate courses of specific drugs. If, when this has been done, some surgical lesion persists such as an abscess, a fistula, a fibrous stricture, a tumour, which might be a co-incidental carcinoma, a chronically inflamed appendix, or prolapsing hæmorrhoids, this surgical lesion may be dealt with by the appropriate operative procedure. Even then it will be advisable to give further anti-amœbic drugs during the post-operative period.

Conclusion

It has been shown from the cases that have been quoted that the most important thing is that Amœbiasis should be suspected as the cause in various persistent and often slowly progressive inflammatory conditions of the intestinal tract. Even after it is suspected, it may be very difficult to establish a diagnosis. This must be done even if only by the therapeutic test. The specific treatment should be applied as soon as possible.

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RECENT ADVANCES IN THE TREATMENT OF CARCINOMA OF THE OESOPHAGUS

Surgery Lecture delivered at The Royal College of Surgeons of England
on
11th April, 1947
by

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THE OESOPHAGUS is one of the common sites for the development of cancer and in England and Wales the annual deaths from this cause number 1,600, of whom 1,200 are men and 400 women. It accounts for 4 per cent. of all deaths from malignant disease and the annual deaths in Europe are estimated at 25,000. It is thus a problem of considerable magnitude and its importance is increased by the miserable death from starvation to which apart from surgical relief its victims are condemned. The failure of surgery to give relief to such a distressing condition until quite recently was not due to any lack of effort on the part of surgeons but to the intrinsic and formidable difficulties of the problems involved. Their solution is one of the greatest feats of surgical team work to which surgeons, anaesthetists and pathologists have all contributed. I shall deal only with cases in the thoracic oesophagus since 80 per cent. occur in this region and here surgery is the only effective resource.

We must face the fact that when first seen carcinoma of the oesophagus is almost invariably an advanced disease, for the first signs are either of obstruction from encirclement of the lumen or of pain from the involvement of surrounding structures. The old idea that it is of low malignancy is not borne out by the facts, for recurrence is common even after extensive removal. There is no escape from the fact that we shall always be faced by a surgical problem of the first magnitude, and this in a patient who must usually be exhausted by starvation and offer a poor surgical risk. Often the first step must be to assure adequate nutrition by a gastrostomy by Janeway's method or by the older plans of Witzel or Senn, or when future freedom of the stomach is essential an opening may be arranged in the jejunum. In almost all cases some such arrangement is a necessary preliminary in a starved and dehydrated patient and with modern technique the risk should be negligible and improvement rapid. In actual experience if nothing else is done the patient's life is not prolonged, but under proper conditions of nursing his comfort is greatly improved.

The risk of infection can be greatly reduced by a course of sulphonamide beforehand, by the use of penicillin locally at the operation and by its injection for some days afterwards. One assumes the utmost perfection

of asepsis, but even this proved inadequate before the introduction of these drugs which have altered the whole outlook of thoracic surgery.

With modern pressure anaesthesia access to the thorax has become as easy as, if not easier than access to the abdomen, for once the cavity is open the lung naturally collapses and we are presented with an empty cavity. Collapse of the lung, so long as it is limited to one side, never leads to any trouble, and it may be packed out of sight and left there with impunity. Just before final closure it is released and as the air pressure is slowly raised it should fill the cavity just before the surgeon closes the opening.

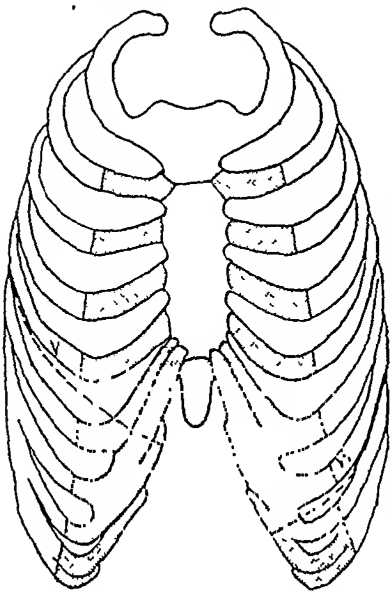

Fig. 1.—Incision for exposure of oesophagus in the thorax.

The actual opening into the thorax is a simpler matter than is generally supposed and many of the precautions taken are unnecessary or even harmful. I regard the removal of a rib as an error in technique for an adequate opening can always be obtained without this and the tying together of adjacent ribs is an essential part of the final closure. Nor need one generally divide a rib, although a rib may crack on forcible separation.

One thing is however often overlooked and is vital to adequate exposure, the incision must be carried so far forward as to divide the costal cartilage at the thoracic margin, as is easily accomplished even if the incision is as high as the fifth space. In this way one end of the lower rib is completely freed and an opening from six to eight inches wide by ten to twelve inches long is easily obtained, with adequate access for any possible operation (Fig. 1).

The mere removal of a growth of the oesophagus presents no great difficulty and we shall therefore consider this first, deferring for later discussion the far more difficult problem of reconstruction. The oesophagus may be approached from either side. As it descends it bends towards the left and therefore in its lower half it is best reached from the left side of the chest, an approach which has the further advantage that the stomach is within easy reach below the diaphragm. Although the upper half can be reached from the left this is not so easy, as the

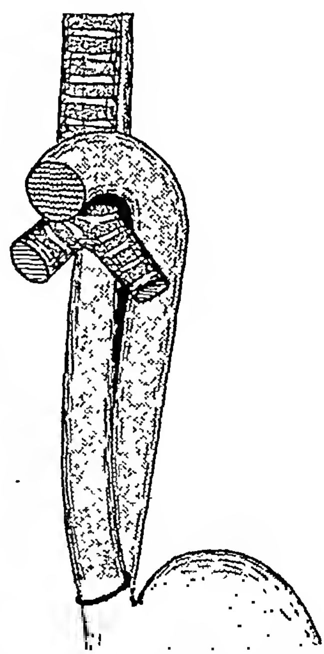

Fig. 2.—Relations of the oesophagus in the thorax.

arch of the aorta and the great vessels arising from it lie in the way. This portion of the oesophagus is most readily approached from the right when the only overlying structure is the azygos vein (Fig. 2).

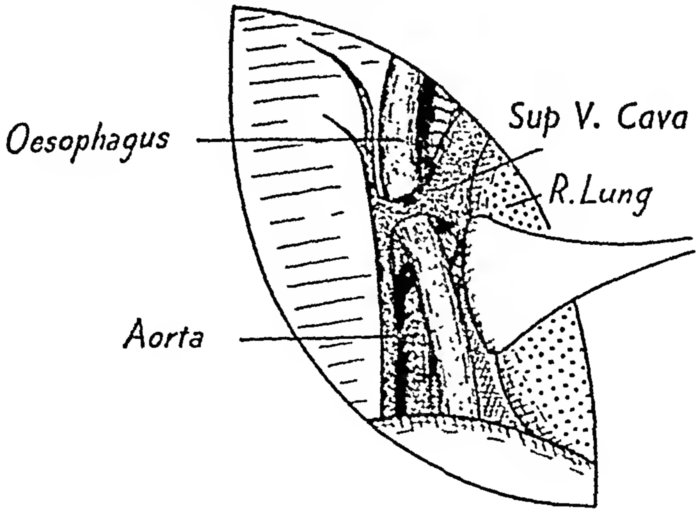

Fig. 3.—Right approach.

On dividing this the whole oesophagus can be exposed from the upper aperture of the thorax to the diaphragm. Beyond this, however, difficulty arises from the heart and pericardium and even if the diaphragm is divided the liver obstructs access to the stomach. The stomach can only be reached satisfactorily by a laparotomy either as a preliminary measure or by a special manoeuvre which we shall presently describe.

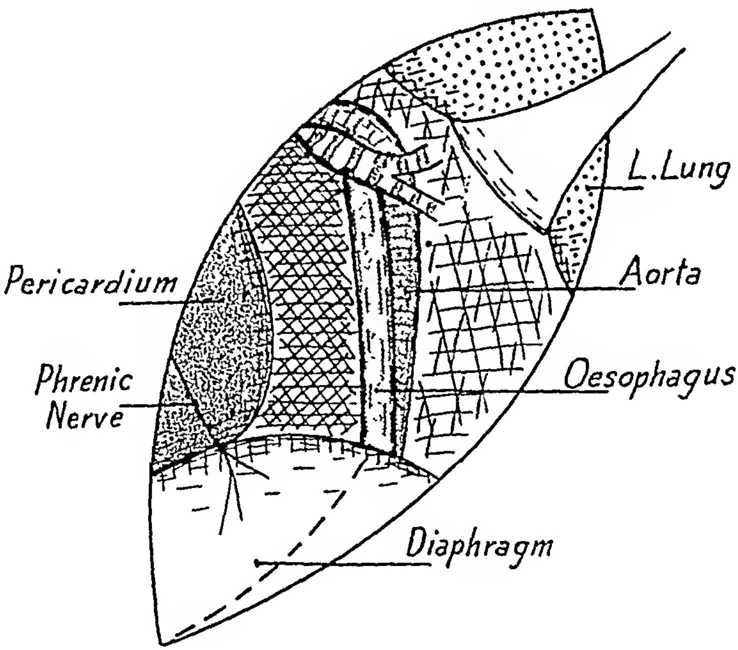

Fig. 4.—Left approach.

Taking first the simpler left approach the patient is placed in the right lateral position with suitable supports, the knees drawn up, the shoulders well forward, and the left arm extended forward supported on a rest. An incision is made along the whole of the eighth or ninth intercostal space and through the corresponding cartilage into the sheath of the rectus abdominis. The pleura is opened with full intrapulmonary pressure and the pressure is then relaxed, allowing complete collapse of the lung. The wound is opened widely with the aid of a powerful rib spreader and the lung is packed away with large hot packs. The phrenic nerve is easily seen as it runs from the pericardium to the diaphragm and its injection with novocain by producing a relaxed and motionless diaphragm greatly facilitates further manipulations and minimises shock. The diaphragm can now be divided in the direction of its fibres from the oesophageal opening to the divided costal cartilage, and perfect access to the whole of the left upper abdomen is thus assured.

On incising its pleural covering the oesophagus can now be readily freed up to the point where it emerges from beneath the aortic arch. The stomach may be freed by division of its vascular and other connections to any desired extent and the oesophagus and stomach can then be brought almost outside the chest. Resection of so much of the stomach and oesophagus as may be necessary is now a very easy matter. The opening in the stomach will be closed, for even if reconstruction is intended anastomosis to the fundus is the better procedure. If however this is not possible the free upper end of the oesophagus is closed and protected, and the upper oesophagus freed by blunt dissection and brought out through a fresh incision in the side of the neck. This however does not require complete movement of the patient for with withdrawal of his left arm to the back and a slight rotation of the head sufficient access for the

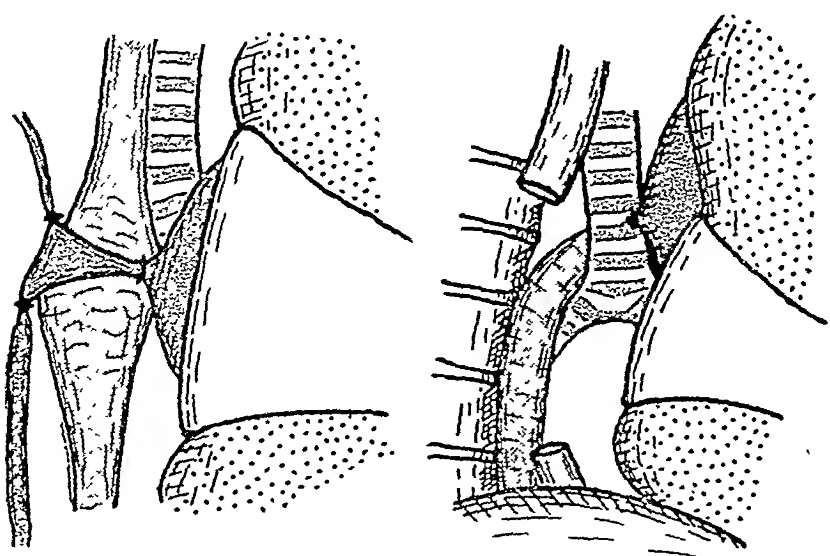

Fig. 5.—Excision of tumour from right side.

purpose can be obtained. The upper stump of the oesophagus is withdrawn through this incision and it is then passed down through a tunnel under the skin to emerge at the second costal cartilage.

To expose the oesophagus from the right side the patient is placed similarly in the left lateral position and an incision is made through the whole of either the fifth or sixth intercostal space. To obtain free access the costal cartilage must be divided right through to the lower thoracic margin. On forcible retraction a wide opening can be obtained and in most cases division of the ribs is quite unnecessary. If simultaneous access to the stomach is desired this may be obtained by extending the incision to the middle line and then downwards either through the linea alba or in the rectus sheath. For the reason already given the diaphragm should not be divided. As access to the upper oesophagus is required the vena azygos is divided between ligatures, when on dividing the overlying pleura the whole oesophagus can be exposed, freed and brought out into the thorax.

If no anastomosis is intended the free upper end after removal of the tumour is brought out on the left side of the neck as already described,

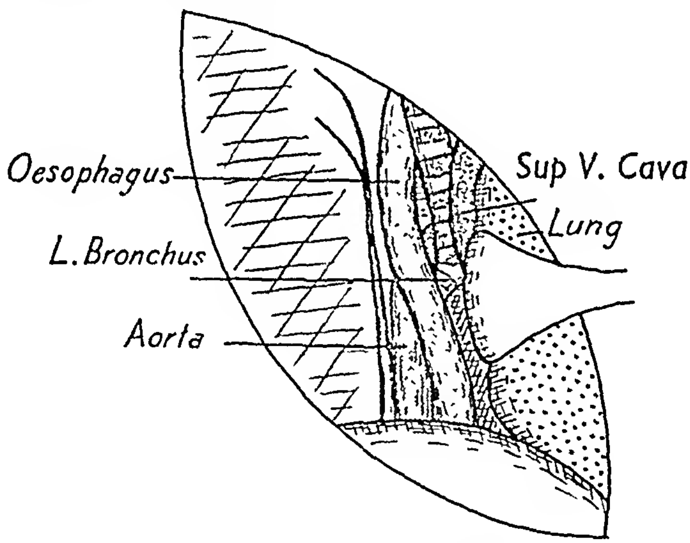

Fig. 6.—Exposure from right side.

whilst the lower end is closed and securely invaginated into the stomach which is returned below the diaphragm.

The operations so far described can be carried out with a very moderate degree of risk considering their extensive nature and the immediate proximity of such vital structures as the heart and lungs. As regards the lung repeated explorations have convinced us that it may be entirely disregarded. It can be completely collapsed and packed out of the way, provided always that care is taken to expand it fully before final closure of the chest. We have never seen any pulmonary complication result from such treatment and the contrast with the pulmonary complications which

may follow an ordinary laparotomy is very remarkable. Division of the vagi appears to be equally innocuous, but their irritation may have serious effects and it is a wise precaution to block them with novocain at an early stage. No large vessels, excepting the azygos vein need be divided, but troublesome oozing may occur from the oesophageal bed and is best controlled by hot packs and local diathermy coagulation. Absolute asepsis at every stage is of course essential, the oesophagus being divided by the diathermy knife, but the local application of penicillin or sulphonamide powder is a valuable aid.

The mere removal of a growth, however successfully carried out, leaves the patient with no means of swallowing, dependent entirely on artificial feeding by a gastrostomy or jejunostomy, and with saliva constantly dribbling from an open sinus on the chest. In recent years therefore great efforts have been made to reconstruct the oesophagus, and with increasing success. These procedures, however, in contrast to those preliminary steps which have been described are of the highest technical difficulty and involve very great risks. Probably these will be reduced by further experience, and in view of what is at stake they are fully justified. For full details of the many procedures attempted reference must be made to original papers, and we can only now give a brief account of a few methods which seem likely to find permanent adoption in the future.

The situation where carcinoma of the oesophagus is most readily dealt with is in the region of the cardia and fortunately this is one of the commoner sites. Whether it is an adenocarcinoma of the stomach which has invaded the oesophagus or a squamous growth of the oesophagus itself is of little technical importance although it may affect the glandular spread. Approach should be from the left and the preliminary stages have been described. With the stomach and oesophagus fully freed the growth is removed with a liberal margin and the opening in the stomach is closed by a double layer of sutures. The fundus of the stomach is now freed by division of the left gastric artery on the lesser curve, the left gastroepiploic on the greater curve and the vasa brevia and connections with the spleen. The fundus can now be brought up into the left pleural cavity to any level that may be required, and it should be fixed in this position by sutures to the chest wall so that it occupies the former oesophageal bed and itself now forms a bed on which the proximal oesophagus can lie.

The remaining oesophagus is attached to the front of the fundus by suture of the muscle and serous layers. A small transverse opening is made in the fundus and an anastomosis made by sutures which include every layer, and finally the fundus is drawn up so as to cover in the line of union. All tension must be avoided, and it must be remembered that in contrast to the intestine, the only layer of the oesophagus capable of holding sutures is the mucosa and even this is very fragile.

Up to the level of the root of the lung this method involves no great difficulty, provided that adequate mobility of the stomach is first obtained. Above that level it is still possible, although more difficult, to effect an

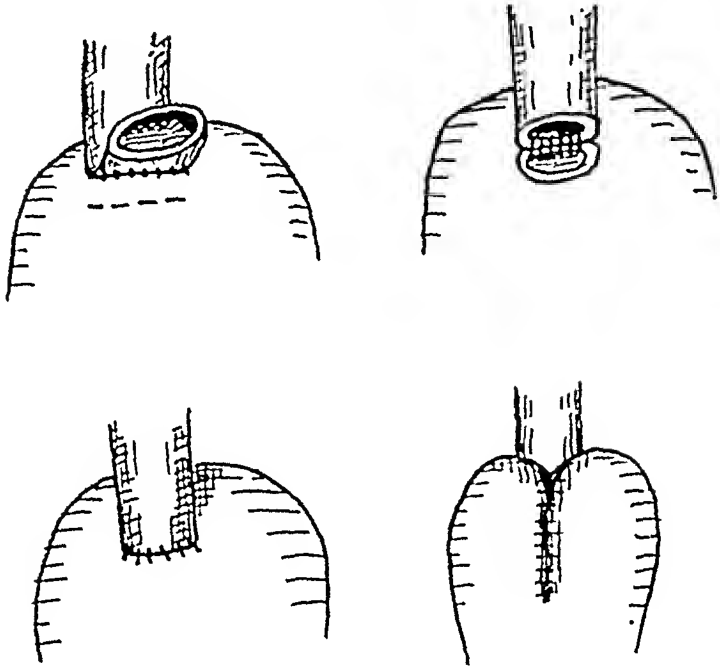

Fig. 7.—Details of anastomosis.

anastomosis by freeing the oesophagus to a high level and displacing it to the *outer* side of the aortic arch, as has been successfully accomplished by Garlock. For such a high anastomosis a right side approach would however seem more appropriate.

For growths of the upper half of the thoracic oesophagus the best approach as we have seen is from the right. An incision in the fifth or sixth space, carried through the cartilages and then downwards nearly to the umbilicus gives liberal access to both the oesophagus and the stomach. If reconstruction is intended the fundus of the stomach must be completely freed as already described from all its vascular connections, the lesser omentum and the left hepatic ligament divided, and the aperture in the diaphragm enlarged and freed from the oesophagus so that the whole of the fundus of the stomach can be drawn up through it into the right side of the thorax. In most cases this presents no difficulty and it may even be possible to bring the fundus up to the very apex of the pleural cavity.

The approach to the stomach from this side is by no means as easy as from the left, but if the incision described is carried right through the cartilages and through the margin only of the diaphragm it will be found that the liver with the hepatic vein and vena cava fall outwards with the chest wall and that after division of the left coronary ligament adequate access to the stomach is obtained. The advantage of postponing the liberation of the stomach until it has been ascertained that the case is operable is obvious. A small but important detail is that for the right

approach the patient should lie almost on his back with only a slight tilt to the left and certainly not fully on his side as in the left approach. The displacement of the liver is facilitated and the anaesthetist has better control.

The oesophagus is now divided just above the cardia, which is closed and buried in the stomach wall. The fundus is drawn up as far as convenient and sutured to the thoracic wall so as to form a bed on which the oesophagus can lie. To this bed the oesophagus is sutured well above the growth which is now removed and the proximal oesophagus anastomosed to the fundus as already described. Owing to the higher level this is more difficult than on the left side and it is well to leave a rubber catheter enfolded in the stomach wall and reaching up to this junction. Apart from this the chest and abdomen are closed as usual, care being taken to ensure full distention of the lung before closure is complete.

Several surgeons have endeavoured to avoid the dangers of intrathoracic reconstruction by ingenious plastic operations outside the thoracic cavity. In these the upper end of the tube is brought out below the neck as we have described and is joined to the stomach which has been brought out from the abdomen and insinuated beneath the skin in front of the sternum. In earlier attempts the junction was effected by means of a tube of skin formed by plastic methods from the skin of the chest wall and of this method Grey Turner was one of the chief protagonists. An important point in technique was to preserve the cardia, bringing out the lower oesophageal stump and passing it up beneath the skin. In this way the new skin tube was protected from the destructive action of the gastric juice. Hermon Taylor has achieved success by a still more daring method, bringing the fundus of the stomach out beneath the presternal skin and anastomosing it after a certain interval of time to the upper stump of the oesophagus by a method almost identical with that which we have described for anastomosis inside the thorax. But in spite of the success which has been achieved by these methods we feel convinced that the future lies with intrathoracic anastomosis.

There remains the very considerable group of cases in which radical treatment is out of the question and in which only palliation can be attempted. Two courses are open, gastrostomy and intubation. In either event all that we aim at is the comfort of the patient and we need not expect, nor perhaps need we desire, to lengthen his life. Simple though the operation seems the immediate mortality of gastrostomy is in fact considerable, though I am convinced that this should not be the case if adequate precautions are taken. It should certainly be performed under local anaesthesia, which is perfectly adequate for the purpose, and with accurate technique so that absolute security from leakage is ultimately attained. If these conditions are met the comfort of the patient is greatly increased, but it must be remembered that he will always be dependent on competent nursing and attention. To send him home to domestic management of his feeding is to court disaster.

A recent American enquiry showed the very remarkable result that the percentage of patients alive four months after resection of a malignant growth with reconstruction was greater than that of those alive after simple gastrostomy. Probably such a result is explained by selection, but it is none the less remarkable and encourages attempts at bold surgery.

There remains the method of intubation, and although this is of course only palliative I must say that I have often been astonished at the degree of comfort that can be attained. It should only be used in those cases where there is a tight firm stricture from a growth of scirrhous type, for only in these cases will the tube be firmly held. But it is precisely in these cases that obstruction is complete and that the patient is in the greatest misery from thirst and starvation. The objection has been raised that the tube is likely to ulcerate through the wall of the oesophagus, but the objection is illusory. The tube lies by hypothesis in the centre of a carcinoma which may itself penetrate the lung or pleura and which in just nine cases out of ten will actually do so. But that the patient should be deprived of the comfort, the incomparable comfort of being able to swallow, because of such a risk seems to me to show a complete lack of appreciation of the situation. I have seen case after case where swallowing was retained for months until the inevitable close, and I have actually followed these cases for as much as 18 months living in a degree of comfort that could be obtained in no other way.

The spiral wire tube which I introduced many years ago allows the maximum lumen possible and as it is flexible and yet incompressible it meets the somewhat exacting mechanical requirements. But its introduction demands an accurate technique. A large oesophagoscope is required but with practice this can be introduced without undue difficulty. The tight stricture which I regard as an essential indication must be carefully dilated, and through this the tube must be passed without force. Its passage is greatly facilitated by inserting into its end a glycerine suppository of suitable size which acts as a pilot and is then almost immediately dissolved.

In view of the serious condition of these patients and of the fact that the tube may become blocked if only temporarily, I now prefer to combine intubation with gastrostomy, the latter only being used in emergency, but always being available as a last resort. One hopes that as experience improves our technique, more and more success will be achieved in the radical treatment of this grave condition, but it is as well to remember that we have at our disposal these simpler means of relief.

INJURIES AND CICATRICIAL STENOSIS OF THE LARYNX

Post-Graduate Lecture delivered at The Royal College of Surgeons of England

on

7th May, 1947

by

V. E. Negus, F.R.C.S.

THE SUBJECT of injuries of the larynx and cicatricial stenosis is somewhat limited in its scope, but is of some importance; for these conditions are very distressing to the patient, and any relief given is much appreciated.

Etiology

Injuries of the larynx are not common, first because the organ is well protected. The chin and sternum prevent it from being injured in most falls and accidents, unless the patient happens to be thrown against some horizontal object such as the top of a fence or the windscreen of a car, which strikes the larynx. One can, however, say that although injuries of the larynx are uncommon, those which do occur can be very serious. Direct injury does not produce a great number of cases in practice; the reason they are infrequently seen is the neighbourhood of vital structures. In the case of razor cuts and wounds by bullets or pieces of shell, the neighbouring carotid sheath and vertebral column are such vital structures that death may easily take place by the cutting of a vessel or damage to the spinal cord, either in an oblique or antero-posterior direction. Therefore, although the number of cases one sees is not very great, there are a considerable number of others which are not seen because of the sudden death of the patient, as with wounds of the heart, where the majority of subjects do not survive to reach hospital. The only fast missile likely to injure without causing death is one travelling in a transverse direction, when it can produce injury to the front of the larynx.

We therefore have as the main causes of injuries blows or crushes, or, occasionally, direct injury by a projectile; but the larynx, being moveable and resilient, may often escape.

Another cause which does not properly come into this category, is a wound of the neck with paralysis of the vagus; the nerve is seldom cut, but more often pressed upon by a haematoma.

In summarising possible injuries of the larynx, one has, therefore, blows or falls on the larynx, battle wounds, and razor cuts—not only self-inflicted but also inflicted by others, as in razor fights. Self-inflicted razor wounds are usually ineffectual attempts as suicide. The people who resort to this method do not do the job efficiently; instead of cutting

through the carotid sheath, they make a cut across the front of the larynx, not sufficient to kill.

In dealing with injuries in this region, one also has to take into consideration that which may follow the insertion of a high tracheotomy tube—cricotomy instead of tracheotomy—with perichondritis and subsequent stenosis. Another cause may be the application of diathermy to the larynx. I myself look on diathermy for the treatment of a neoplasm of the larynx as somewhat precarious unless carried out with the utmost delicacy; one sees cases where cohesion or stenosis follow this method.

Cicatricial stenosis is sometimes met with after operations such as laryngo-fissure, where there has been infection or cicatricial contraction after removal of the vocal cord.

Pathology

The type of wound varies according to its direction and position. In falls on the larynx, the thyroid cartilage does not easily fracture, but there can be very severe damage from *sub-mucous hæmorrhage.* One sees cases where the patient has fallen on the front of the neck without any obvious injury at the time; I have, for example, observed an instance where a boy was thrown from his bicycle and struck his neck against a fence, being at the time apparently little the worse for the accident. A week later there was complete stenosis, the explanation being sub-mucous hæmorrhage; if one had looked at the larynx, one would probably have seen bluish infiltration in the sub-glottic region, or under the cords themselves. The supra-glottic and sub-glottic regions can easily be distended with blood, and when that happens, the serum oozing through may cause the surfaces to adhere.

Surgical emphysema may occur in what otherwise seems to be a slight accident; if there is the slightest tearing of the mucosa, the patient may force air into the tissues, probably with some mediastinal emphysema, very great dyspnœa resulting from what appeared to be a minor injury.

In incised wounds, *hæmorrhage* into the trachea may be of such amount as to kill the patient.

Returning to the question of the insertion of a tracheotomy tube, it is well known, but not always observed in practice, that the wrong placing of the tube is likely to set up *perichondritis,* with subsequent stenosis or suppuration, sometimes followed by septic bronchitis or bronchial pneumonia. Even if the perichondritis is not sufficient to kill the patient, and not sufficient to cause cicatricial stenosis, it may still prevent normal respiration by leading to arthritis of the circo-arytenoid joints, with fixation.

Cicatricial contraction follows injury in many cases, and can lead to stenosis, either through perichondritis or by the formation of granulations.

Another result that can happen in association with damage to the larynx is *perforation of the oesophagus.* I have seen two cases, one a woman who cut her throat, and another a man demolishing a wall which collapsed under him and precipitated him onto a spiked railing. Death did not occur in either case because the patient had a stricture at the top of the trachea just below the opening into the œsophagus, so that fluids could pass into the larynx but not down the trachea.

Stenosis of the larynx in a child, treated by the insertion of a tracheotomy tube, results in *lack of development of the larynx,* and makes the stenosis more obstructive in adult life, as Chevalier Jackson has pointed out.

Symptoms

The symptoms are fairly obvious. Fixation of the arytenoid joints, formation of granulations, or perichondritis, all produce *hoarseness.* If the stenosis is complete, there is total loss of voice; one has seen patients who have not spoken for 23 years. *Dyspnœa* is another obvious symptom, its severity and time of onset depending on the degree of obstruction. Delayed onset is a thing to beware of; tracheostomy has had to be performed on patients who had been injured several days or even a week previously. *Cough* will follow the inhalation of blood, and is to be encouraged in early cases; later, it is not a sign of any importance. As soon as stenosis becomes established, there will be no cough unless it arises from bronchitis following the insertion of a tracheotomy tube.

Signs

One may feel a fracture of the cartilages; but treatment of a fractured cricoid would have to be very rapid if the patient were to be kept alive. Looking inside the larynx, it is quite easy to see sub-mucous hæmorrhage. The bluish infiltration can be mistaken for a new growtn. The surfaces of the glottis seem to have a remarkable ability to cohere, as one sees injury after diathermy.

If there is obstruction of the airway, with a small wound, surgical emphysema will be likely to appear and increase. This does not matter very much in the neck or head, but in the mediastinum it will soon kill the patient, and opening of the trachea is therefore urgently needed.

The immediate danger of an external wound is from blood filling the trachea. Later, of course, there is also danger of infection and perichondritis.

Treatment

Regarding the action to be taken in these cases, there is little to be done when dealing with a slight injury except to keep the patient where he can be under close observation and can, if necessary, have tracheostomy. If allowed to go away, help may not be available when it is urgently needed.

When dealing with an incised wound, the patient should be kept propped up. Morphia should not be given because of the danger of

suppressing cough, with consequent flooding of the trachea. In an incised wound such as a cut throat, it is somtimes justifiable to insert a cannula through the wound temporarily, but it is quite unjustifiable to leave it there. A laryngeal cannula, or a cannula through the crico-thyroid membrane, may be very useful for a brief period, but if it is left in for more than a few hours, there is the danger of perichondritis, and it should be replaced at the earliest opportunity by a properly placed tracheostomy.

A perforating wound may be enlarged, the lacerated edges removed, and penicillin and sulphonamide powder dusted in, with a very good prospect of avoiding infection. For an extensive wound, systemic penicillin is a prophylactic against infection, these cases being extremely dangerous.

As to treatment at a later stage, nothing can be done to prevent stenosis by strenuous efforts in the early stages; whatever method one uses, irritation of the larynx is increased by the introduction of a foreign body such as a rubber mould. The right treatment is to avert death at the time, by tracheostomy if necessary, and to wait until there is subsidence before attempting more.

The first thing to do if there has been a high tracheostomy is the replacement of the tube through a properly situated opening at the level of the third and fourth rings of the trachea. This is sometimes overlooked. I have had cases where stenosis has increased for a long time after injury owing to inflammation and granulations caused by a cannula remaining near the cricoid cartilage, when it ought to have been replaced lower down. This applies to the treatment of all cases of laryngeal stenosis, permanent stenosis being caused by a cannula in the wrong place. There is no reason to allow an asphyxiating patient to die by wasting time counting the rings of the trachea, but there is no excuse for leaving the tube in the wrong position. The first thing to do, therefore, even in the later stages of treatment, is to shift the tube if it has not been correctly placed.

The next thing is to consider whether one can do any good by periodic dilation. I myself very much doubt it. I consider that all such methods are useless, and will not produce any good permanent results, even with a small degree of stenosis. What should be done, is to wait until all activity has subsided, then to restore the lumen and prevent the surfaces from re-adhering by means of skin-grafts. The treatment referred to is a method which I consider essential to success.

Treatment of these cases has often been unsatisfactory, but I do not think that this should be so. Methods such as repeated dilatation or the insertion of moulds without skin-grafts may give good results at first, but after a short time stenosis is found to have recurred. In France there was used open laryngostomy, with what was termed a "cigarette" to hold the lumen open, but this is unsuitable and lengthy.

I believe the right treatment is to wait until the active inflammation has subsided, then to open through the laryngo-fissure route, divide

the adherent surfaces, remove scar tissue and finally restore the lumen, maintaining it by the insertion of a skin-graft. Rubber tubing has been used in the past for this purpose, but I think that in the future plastic tubing, such as Portex, will be the choice. In the few cases I have seen so far where plastic tubing has been used, the results appear better, as it is less irritating than rubber, although also less resilient.

The tube is held in position by transfixion with a silver wire passing through the thyroid alæ, as recommended by Schmiegelow, or by a wire passing round the tracheostomy cannula. The skin-graft can be placed in position either before or after inserting the tube. The tube can be removed at the end of a period varying from 12 days to as much as two months, and there is not usually any further trouble unless the supporting cartilages have been very seriously damaged.

I do not believe that it is of the slightest use merely to divide a laryngeal web, as this usually leads to disappointment following the reappearance of the web.

I do not think one can treat these cases on fixed lines, as they vary from case to case, but generally speaking, they can be restored by using a skin-graft. If there has been much destruction of supporting cartilages, the tube or an obturator must be kept in place for a long time, possibly as much as four months.

For cases of laryngo-œsophageal fistula, special modifications are required. One case was successfully dealt with by myself, but another had eventually to be referred to Mr. McIndoe; he separated the trachea from the œsophagus, closed the hole in each and prevented breaking down of the repair by inserting the mobilised lower end of the sterno-mastoid muscle between the two.

Results

What are the results of these cases? What the patient mainly desires is to get back his voice. If one can restore that, even as a whisper, it is something. These patients do not learn air-swallowing and œsophageal speech, and if no satisfactory restoration of the lumen is obtained, they do not speak at all. If you restore the voice, you are doing a great deal, and if you can restore the power of respiration through the larynx, you are doing still more. In the greater number of the cases seen, if there has not been much destruction of cartilage, one can restore both. There are, of course, certain cases where the first but not the second can be accomplished, and in such cases the right thing is permanent tracheostomy.

If attempts to restore the lumen fail, it is unwise to persist too long, as repeated attempts sometimes destroy what little voice there is. There is no great disadvantage in a permanent tracheostomy, and a tube of suitable type, fitted with an inspiratory valve, can be worn without being apparent.

There are many patients who can manage well without a tube, but some experience dyspnœa on exertion; I have known a patient to ask for his tube to be replaced because of mild disability, after which there was no further trouble.

It is, of course, necessary to warn patients who wear a permanent tracheostomy tube not to indulge in swimming, as they are liable to drown themselves.

SURGERY IN TWO WARS

1914-18, 1939-45

by

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Before comparing either the surgical procedures, or the success which attended them, in the two wars of 1914-18 and 1939-45 it is necessary to consider both the social conditions under which the troops existed and the differences in the types of warfare during the two periods, for in comparing the results of surgical procedure it is essential that these factors be taken into consideration.

Social Conditions

In 1914-18 over the great majority of the fronts and especially in Europe, the static conditions of the war, and the trench warfare thereby necessitated, led to the men living in underground shelters, ill ventilated, ill heated and during the winter, frequently with cold and stinking mud up to the knees or above, while the hygiene necessitated by this static war, and the hasty and inadequate burial of the dead, often in the walls of the dugouts themselves, led to insanitary conditions, horrible odours and infestation with rats and vermin which rendered life disgusting and almost untenable. Can it be wondered that after being wounded, men had no desire to return to these conditions in the front line? Furthermore, but little attention was paid to the importance of proper cooking and service of the rations, and indeed such was very difficult in the front and reserve trenches under direct fire from the enemy batteries and rifles, so that food all too frequently consisted of a prolonged diet of bully-beef and biscuits or at best, par cooked meat with inadequate vegetables. As a result of this, the men's physical condition and their power of recovery from wounds and infections and indeed their whole resistance to infection, was definitely very poor.

Turning to the 1939 war with its mechanised and armoured vehicles necessitating open and mobile warfare on all fronts, once the initial period of waiting warfare in France was terminated by the German breakthrough, one had troops continually on the move and this in itself necessitated a physical fitness and mental alertness, and provided change of scene and change of locality which permitted of adequate hygiene, open air and exercise and kept the men fit and alert. Furthermore the very thorough graduated training which the troops underwent at home before proceeding

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overseas, gradually acclimatized them to active service conditions, conditions very different from those met with in the 1914-18 war. Such men were desirous and capable of an early return to the fighting front. Furthermore from the early days of the war, care and attention were paid both to the type of ration issued, its cooking and the ensurance that a variety of diet was available, and in this respect great credit is due to the initiative of the Royal Army Catering Corps ; but it must be remembered that the whole conditions of warfare permitted of far more adequate delivery of rations and the ability to cook and serve them in an appetizing manner in the field.

Warfare

Again the type of warfare was entirely different in the two wars. In the cramped, unhygienic and uncomfortable conditions of intense cold and wet under which we have seen the troops lived in the dugouts and trenches in the 1914-18 war with its static front, there was no chance of exercise or mental relaxation from the horrors of war or the anticipation of battle where the expectation of death amounted almost to a certainty, for it must be realized that the casualties in a battle of the 1914-18 war such as the Somme, actually exceeded the total loss of life in the whole of the 1939-45 war. Can one be surprised therefore that the wounded in 1914-18 looked forward with horror to a return to the front and apart from their physical unfitness, had a mental revulsion which greatly retarded their recovery. In the 1939-45 war, on the other hand, with its active movement, with the exciting anticipation of parachute drops and aeroplane descent and the necessity of maintenance of weapons, tanks and armoured vehicles, often under very difficult conditions and with the knowledge that great distances had to be covered, the troops were kept physically fit and mentally alert with pre-occupation in vehicle and weapon maintenance which kept their minds off the immediate risk of battle. Such men, fit and well fed, had not the antipathy to return from hospital to the front and their recovery was thereby accelerated.

Mobile Surgical Teams

It was, of course, difficult to deal with prompt surgical procedures in this very mobile warfare and it took the medical services some little time to devise a scheme whereby surgery would be available to the wounded within a few hours of injury occurring. This was ultimately met by the formation of mobile surgical teams.

These teams constituted one of the greatest advances in surgery in the 1939-45 war. At the commencement, as might be anticipated, was a period of trial and error when the over-enthusiastic, both medical and combatant, pushed isolated teams far too much to the front, forgetting such essential facts as that a mobile battle swayed to and fro over ten or fifteen miles and that a team pushed forward on its own was not only over-run and captured and re-captured, a process which interfered with its smooth working, but also that a solitary team was incapable of

carrying on indefinitely and unable in the front line to retain its casualties after operation, for that ten-day period which is so essential for their full recovery. Later therefore, it was realized that the mobile surgical teams must be both held at some distance from the battle area, that two or three must be grouped together to ensure continued surgical service during each twenty-four hours, further, in order to ensure the retention of patients for ten days and their adequate nursing, so much more efficient in the hands of women than of men, these teams were usually located as an advanced surgical centre with a casualty clearing station. Here such valuable adjuncts as female nursing, X-rays and blood transfusion were available to the advanced surgical teams; while patients could, with reasonable certainty, be assured of that essential ten-day retention after operation.

Specialised Centres

During the 1914-18 war there were evolved certain separate hospitals for the care of abdominal cases, head cases and fracture cases, but these were, with the exception of the abdominal cases at Casualty Clearing Stations behind the fixed line where early surgery was thus ensured to them, only segregated at the base hospital. During the 1939-45 war however, specialisation has been pressed much further forward and to a far greater extent, so that we may perhaps pause and wonder if specialisation has not occurred in excess of common sense and the interest of the patient. We have had as far forward as the Casualty Clearing Station and on some occasions attempted at the Field Ambulance, specialisation in orthopaedic, plastic, thoracic, cranial and other surgical specialities while the formation of transfusion, pathological and X-ray units has been carried forward to the Casualty Clearing Station and even to the Field Ambulance. As a general rule it may be said that speciality should not be advanced further forward than the Casualty Clearing Station with its advanced surgical centre, and that in the main, specialities and specialists are better held at the base hospitals, the casualties being dealt with in the field by general surgeons on certain well-defined principles agreed with the specialists. Possible exceptions to this rule occur in the case of orthopaedic and thoracic units which can, under certain conditions, be advantageously situated at the advanced surgical centres in the Casualty Clearing Station and here too is the best position for the blood transfusion, pathological and X-ray units.

Blood Transfusion

Probably one of the great advances of this war is to be seen in the institution of blood transfusion, forward and given almost as a routine. This transfusion service has been rendered possible by a voluntary sacrifice by masses of the British people to whom great credit is due for the saving of the lives of many wounded, both in the services and among the bomb casualties amongst the civil population at home. The preparation of

plasma in large quantities has rendered possible adequate transfusion in the advanced dressing stations of the Field Ambulances and even occasionally in the Regimental Aid Post, but it must be remembered that transfusion is an operation which must be carried through only in the presence of adequate asepsis. Amidst the mud and blood of the average Regimental Aid Post in battle it is dangerous and has been known to produce fatal septicaemia. A further word of warning is necessary as to the giving of excessive amounts of blood or plasma in the absence of hæmorrhage from a wound. As a general rule, all blood lost should be replaced quantity for quantity and an extra pint or even two pints administered subsequently, but in cases of shock where no hæmorrhage has occurred, blood must be given slowly and cautiously, not more than forty drops to the minute in rate and seldom more than two pints in total quantity is necessary before the patient's pulse becomes perceptible within the limits of normality, thus indicating that transfusion should be stopped. Should this period be missed, a rising pulse-rate and rapidly increasing respirations may lead to the erroneous and dangerous administration of blood and plasma which is often fatal in its results, the patient dying of pulmonary oedema, or uraemia following blockage of the renal vessels with disintegrating and unexcreted red cells.

Chemo-therapy

A further advance available to surgery in the 1939-45 war has been the tremendous strides made in the chemo-therapeutic control of infections following wounds. When the war started we had available the sulphonamide group of drugs and full use was made of these. As a general rule it may be stated that their administration orally in doses of one gramme four-hourly for the first twenty-four or forty-eight hours and subsequently half a gramme four-hourly until the infection is controlled as shown by a fall in temperature and pulse, is far more adequate than their local application to the infected wound. Again it must be remembered that in staphylococcal infections they have little or no effect and that if their administration is not followed by a fall in temperature and pulse by the end of forty-eight hours they should be discontinued for they are intensively toxic especially to certain individuals and vomiting and hæmaturia, strangury and even uraemia have followed their excessive use. About 1943 we were fortunate in obtaining penicillin as a chemo-therapeutic agent and here was one which definitely destroyed the staphyloccus and most organisms except in those of the B.coli typhosus group, B. pyocyaeous and the tubercle bacillus. Applied locally to the infected wound, provided it could reach all parts of the infected surface, it was adequate in clearing up local infection and indeed if applied to the recent wound, was a satisfactory prophylactic to the appearance of infection, provided that early and adequate surgery were combined with its use. It was, however, when given systematically that penicillin proved of great value in combating both general and local infection at the same time. It had of course to be given

intramuscularly and as frequently as every three hours in order to maintain a sufficient concentration in the blood stream to combat infection, but its results were almost miraculous in combating even the dread infection of gas gangrene and preserving the lives and limbs of the wounded. No wonder that the combatant traversing the wards of the base hospitals commented on the absence of the thin, anaemic, apprehensive and pain-racked patient with his septic wounds, so often seen in the 1914-18 war.

SURGERY

With these facts in view and bearing in mind their effect on the physical fitness and will to recover on the part of the average soldier, as well as the additional advantage in combating both loss of blood, shock and infection to both surgeon and patient, we can proceed to consider in some detail, a comparison of surgery in different types of wounds in the two wars. As a general rule, one can say that the principles of war surgery have remained essentially the same in both wars. Unfortunately both the lessons and the literature so painfully learned and accumulated as a result of the 1914-18 war had been largely forgotten by surgeons and lost to surgery in the interval between the two wars ; nor was the literature of the last war adequately studied at the beginning of the 1939-45 campaigns, for which reason, knowledge had to be painfully acquired and principles gradually enunciated by the surgeons of this last war at the expense in its early days of both efficiency in surgery and suffering to the patient. It is undoubtedly a fact that the damaging power of the missiles used in this war has been much greater than those in 1914-18, though their concentration has been much less. Individual damage inflicted by the higher explosive power bursting the projectile, the arrival of projectiles from the air in the form of bombs with a devastating range of destruction in all directions has made them far more damaging to tissues than was the case in the 1914-18 war when shells arrived with a known trajectory and from a known direction so that adequate steps could be taken for protection. Against this must be set off the greater protection afforded to the troops by the armouring of the vehicles in which much of the battle was conducted and the preliminary sweeping up of the battle area by these armoured tanks before infantry assault was carried out. On the whole therefore, severe lacerated wounds with considerable disruption of the surrounding tissues were both commoner and more severe in the 1939-45 than in the 1914-18 war. The surgical principle of operation within six to ten hours, excision of a thin margin of skin and all damaged and infected muscle tissue until red contractile muscle with spurting vessels was encountered held equally good in each war, and equally good whether chemo-therapy was applied or not, for it has been proved abundantly that adequate chemo-therapy is but an adjunct to early and efficient surgical excision of every wound, as it is but an adjunct to adequate drainage of pus or removal of sloughs in all cases of infection. It is safe to say that the period of suffering especially painful at the time of dressings,

and long convalescence has been largely saved to the patient in this last war; firstly and in the early days, by the routine plaster treatment of all wounds, a treatment which was however originally carried out by some few surgeons during the 1914-18 war with admirable results, and later by the employment of penicillin therapy as a prophylactic to infection in all cases of wounds, with the employment of secondary suture in a few days where this was possible without undue tension and even primary suture in selected cases. In the 1914-18 war primary suture in any wound was fraught with grave danger and inevitably resulted in breaking down of an infected wound and often gas gangrene with loss of limb and life; while secondary suture, even if carried out as late as ten days after wounding was by no means certain of success. In 1939-45 primary suture and delayed primary suture, i.e., suture within the first three days subsequent to wound toilet have been carried out on a very large number of cases in all theatres of war and combined with routine chemo-therapy especially systemic penicillin, has resulted in successful healing in 80 per cent. of the cases in flesh wounds and 73 per cent. in lacerated wounds associated with fractures; while secondary suture, carried out under similar conditions, has had success in approximately 75 per cent. of cases in both classes of wound. This result is greatly in advance of those achieved by similar procedures in the 1914-18 war or the early stages of this war when chemo-therapy was not available.

Here then, we have a definite advance, both shortening the patient's convalescence, diminishing his pain and allowing of earlier return to duty thus conserving the manpower of the nation.

Lastly, before passing to the consideration of wounds of individual viscera, it cannot be stressed too strongly that the mortality of multiple wounds which occurred in this war with more frequency than in the last, was very considerably higher than those involving one viscus alone (58·3 per cent. as against 39·7 per cent.). With the advent of chemo-therapy, the local application of sulphonamide to the wound of a limb, or the general effect of systemic penicillin, will in some cases permit a perforating wound of the abdomen, chest or head to be dealt with and a limb wound to be left for toilet until the following day when the patient's condition has improved, but in many cases this is not possible as the multiple wounds involve head, thorax and abdomen and all need urgent treatment.

Burns

Burns have been far more common and far more extensive in area during this war than the last. This is partly due to the increased amount of petrol in use both for domestic purposes and transport and partly due to the conditions under which the extensive campaign in the Middle East was carried out in the deserts of North Africa where no fuel, save petrol was available. It is very difficult to obtain any figures of the mortality resulting from these extensive superficial burns as many of them died even before they could reach medical aid or after first aid treatment before getting back

to base hospital. The establishment of definite burns units subsidiary to the plastic units has undoubtedly been of very great value in the treatment of those burns which reach them, for as we knew from civil experience, an experienced team is of far greater value in treating this sort of injury than the haphazard care of casual nursing, even though this be willing as it is. Many lines of treatment have been adopted and there are few units which have the same established routine practice, which demostrates that there is surely much work to be done in the treatment of burns and the perfection of rapid and satisfactory results. The plastic surgeon is all too prone to judge the results of burn treatment by the scars he produces or rather their absence, and to lose sight of the mortality resulting from the burn in itself before a patient comes to his care.

Abdominal Wounds

In considering perforating wounds of the abdominal cavity, we must bear in mind that it is seldom that one viscus alone is damaged. Usually there are multiple wounds of the small intestine, often wounds of the large intestine and the bladder and perforation and disruption of one or more solid viscera, while abdomino-thoracic wounds are not by any means uncommon, constituting about 12 per cent. of the total wounds involving the abdomen and thorax. As a general rule it may be said that whereas in the 1914-18 war a perforating abdominal wound carried an overall mortality of 70 to 75 per cent. and approximately 50 per cent. of those operated on recovered; in the 1939-45 war a similar wound carried an overall mortality of 50 per cent. with a recovery rate of 30 to 35 per cent. This better prognosis in the 1939-45 war was partly due to the possibility of earlier surgery owing largely, I think, to the lesser number of wounds occurring in battle to the proportion of surgeons employed in their treatment, for the routine of treatment of these conditions, early laparotomy and a meticulous and methodical search of the intestinal tract from end to end was identical in both wars. Suture of perforations is performed preferably, unless the small bowel or its mesentery is greatly disrupted when excision and anastamosis are performed, and these procedures have been carried out in both wars. In the case of large intestine wounds however, the 1939-45 war in its latter part saw a great advance in the routine exteriorization of the colon in all wounds of the large bowel, and the performance of colostomy in wounds of the rectum. This led to a very considerable diminution in the mortality from these wounds. In the light of further experience it appears that exteriorization of the caecum and ascending colon is not only unnecessary but makes an additional risk for the patient as against those cases where such wounds are treated like those of the small intestine by primary suture, and most surgeons have I think, now agreed that this is the better practice to adopt in wounds in the caecum and ascending colon. Furthermore the closure of the colostomy or restoration of the exteriorized bowel to the abdominal cavity is not entirely free either of immediate or remote mortality. The

introduction of chemo-therapy moreover has undoubtedly improved the prognosis in cases of wounds perforating the abdominal viscera; but the introduction of sulphonamide powders into the peritoneum is fraught with the considerable danger of subsequent adhesions and intestinal obstruction and is not a practice to be indulged in with impunity.

Wounds of the Urinary Tract

Wounds of the *bladder* are not of very great frequency unless associated with fractures to the pelvic bones and often with injury to the rectum. The treatment of the bladder wound is by primary suture or where other viscera are involved, by suprapubic cystostomy. The *ureter* is seldom damaged alone. The *kidney* is not infrequently damaged and usually needs excision, an operation attended with a low mortality unless, as is not infrequent, other solid viscera are involved or the wound has penetrated into the thorax.

Wounds of the Spleen

Wounds of the spleen are not infrequent and generally associated with lesions of the stomach or thorax. Splenectomy is frequently called for.

Wounds of the Liver

If severe, wounds of the liver produce rapid death and if slight seldom call for drastic surgical intervention. At all costs, plugging with its risk of subsequent infection, must be avoided. Here again other viscera are usually involved.

Abdomino-Thoracic Wounds

These, as already stated, constitute about 12 per cent. of wounds of the abdomen, and their mortality as is to be expected, is very considerably higher than those involving the thorax or abdomen alone. Whether the thoracic or abdominal lesion should be first dealt with depends both on the nature of the injury and whether a general or thoracic surgeon is tackling the case. As a general rule it is better to deal first with the thoracic lesion, suturing the wound of the lung and of the diaphragm, and then tackle the abdominal damage.

Wounds of the Thorax

Wounds of the thorax have occurred with considerable frequency in both wars. It has been the practice in both to treat an uncomplicated hæmothorax by aspiration alone; the complication of infection, with frequently fatal results, has occurred in both wars. Whereas in the 1914-18 war infection occurred in some 54 per cent. of cases of hæmothorax treated conservatively, in the early part of the 1939-45 war infection occurred in 33 per cent. with a death rate of 6 per cent., whereas subsequent to the introduction of systematic chemo-therapy in

these cases, the infection rate has dropped to 6 per cent. with a death rate of only 1 per cent. Of all thoracic wounds, approximately 10 per cent. were complicated with abdominal injuries and as might be expected, the death rate in these cases of abdomino-thoracic wounds was considerably higher than those of uncomplicated thoracic wounds (approximately 50 per cent.). In all wounds causing an open hæmothorax, early closure of the gap is essential but it has been shown that in the front line this can be achieved quite efficiently by a large dressing tightly applied and it is advisable that such cases should not be treated by operation in front of the advanced surgical centre.

It is difficult to make an accurate comparison for, to date, figures from cases in the 1939-45 war are difficult to obtain, nor are the long-term complications yet manifest, but the results of the average percentage mortality of the various wounds of abdomen and thorax are epitomised in the attached table.

Percentage Mortality Table of Wounds in the Two Wars

1914-18	*Organ*	1939-45
51%	Perforating wounds of abdomen ..	39·7-47% { Suture 20% / Resection 58% }
50-55%	Small Intestine	32-40%
50-73%	Large Intestine (Colon)	36-40%
49%	Rectum	25-70%
61%	Stomach	29-38%
30%	Bladder	5-20%
29%	Liver	18%
26·6%	Kidney	5-45%
53%	Spleen	13%
65-85%	Abdomino-thoracic	27-60%
54%	Thoracic	5·7%

Fractures

There are probably far more fractures in this war than in the war of 1914-18 largely because of the increase of motor transport and the greater facilities for the playing of sporting games. For it must be realised that a larger proportion of the wounded heroes of Britain have gained their damage from injudicious use of motor vehicles and aircraft and the over-enthusiastic playing of games than from wounds inflicted by enemy action. It cannot be emphasized too strongly that in severe lacerating wounds involving bones, the primary duty of the surgeon is the treatment of the wound with meticulous excision of all damaged muscle tissue. The reposition of the bone fragments in good anatomical position is of secondary consideration to this, which prevents the danger of gas and other infections. It is further to be noted that in the majority of severe war injuries there is temporarily a complete lack of pain and muscle relaxation in the damaged limb which is seldom, if ever, met with in

civilian practice and which makes the restoration of anatomical position in the bone fragments a comparatively simple task. In all these cases routine administration of anti-gas serum and the chemo-therapy and the fixation of the wound in plaster of Paris in extension are essential to the safety and comfort of the patient and the restoration of good function. Here it should be emphasized that over distraction of the fragments, a practice to which there has been an inclination in this war, just as much as the increased violence of disruption, accounts for the marked delay in union which has been seen so systematically amongst fractures in the 1939-45 war as compared with the 1914-18 war. The routine surgery and results obtained are on the whole equally good in both wars. Before leaving the subject of fractures it should be emphasized that in all cases where main vessels are injured and nerves divided and more especially if joints are laid open and muscle grossly crushed, it is a life-saving operation to perform immediate amputation, and if a tourniquet has been applied, without its previous removal from the damaged limb.

Injuries to Peripheral Nerves

Probably in the treatment of peripheral nerve injuries more than any other, much had been forgotten that had been learnt in the 1914-18 war and this had to be painfully re-learnt. As a general rule it would appear that the results obtained are much the same as those in the 1914-18 period. That is to say that primary suture without tension or torsion gives by far the best results and this is more often possible with adequate chemo-therapy than was the case in 1914-18. Nerve grafting and other operations to try to restore gaps are of little value in obtaining any result of use to the patient and where a gap cannot be bridged by mobilization of the nerve, it is far better, if possible, to remove a section of bone in order to shorten the limb and permit suture. Secondary suture recommended as a routine at the commencement of the war, admittedly gives less satisfactory results than primary suture but is still the practice of many surgeons; where this is carried out it is essential to remove the neuroma which has formed around the ends of the divided nerve before suture is performed. As a general rule it should be realised that the period of recovery is far longer than is anticipated from reading the text books on these subjects; for instance, up to five years is necessary for a high sciatic lesion and two to three years for lesions of the nerves in the axilla or upper arm, and this must be impressed on the patient who must be prepared to submit to a long and tedious period of physio-therapy if any good result is to accrue from the operation carried out.

Head Injuries

As a general rule, head injuries should be dealt with by a surgeon specializing in brain surgery, and it is far better to transfer such cases back after a routine toilet of the superficial wound for they travel well and benefit greatly from more delayed surgery in a special head centre than from prompt surgery in the rough and tumble of a forward surgical centre.

Head surgery, owing to the more general introduction of diathermy, has undoubtedly progressed and given better results in the 1939-45 war.

Wounds of the Spinal Cord

Wounds of the spinal cord are always disappointing in their results, as in the 1914-18 war early surgery to relieve pressure on the spinal cord often resulted in an amazing and unexpected recovery of function, and the introduction of chemo-therapy has done much to diminish the sepsis which was so prevalent and fatal in those cases. In all cases where paraplegia and retention of urine are present, the routine and early performance of suprapubic cystostomy has been proved as essential in saving life and preventing ascending infection in the 1939-45 war as it was in 1914-18.

Gas Gangrene and Tetanus

Before closing I would say one or two words on the subject of those dread infections, gas gangrene and tetanus. During the fighting in the arid deserts of North Africa *gas gangrene* was seldom met with, but once the scene of battle transferred to the fertile fields of Italy and of France the condition was once more manifest, though in my opinion it has been neither so frequent nor so virulent as under the much more unhygienic conditions of trench warfare of 1914-18, and this surely is to be expected. Undoubtedly, the prophylactic use of anti-gas gangrene serum and chemo-therapy have done much to diminish the incidence and virulence of gas gangrene but it cannot be stressed too strongly that without adequate and early surgical removal of all damaged muscle tissue as a routine in every wound, these aids to the prevention of gas gangrene are useless and dangerous if employed alone. *Tetanus* has been relatively seldom seen in the 1939-45 war. This may be due partly to the more mobile warfare and absence of gross fouling of the soil in which the battle occurred as in the 1914-18 trench warfare, but one likes to think that the routine employment of tetanus toxoid has had much to do with the diminution of this dread scourge.

Lastly, in this attempt to contrast the surgery of the two wars, a difficult and, as I shall doubtless find, contentious attempt, I am indebted to many colleagues for their assistance in obtaining the figures and especially to Brigadiers Buxton, H. Edwards and Fettes. As I have stated, these figures are difficult to obtain and by no means final, but I think it can be established that the results of surgery in the 1939-45 war, thanks mainly to the greater promptitude of surgical aid, made possible by the lesser number of casualties in battle in proportion to the number of surgeons available to treat them, and to the introduction of chemo-therapy (sulphonamides and penicillin), have led to a definite amelioriation and fall of death rate in the wounded, though the routine surgical practices have remained the same in both wars, and here Elliott Cutler and Rowley Bristow apparently have reached the same conclusion. The general adoption of the plaster

technique in the dressing and transport of the wounded, a technique rather frowned on in 1914-18, has undoubtedly led, by its greater comfort for the patient, to a great lessening of shock and this has been further maintained by the routine and general use of blood transfusion. It would appear therefore, that our patients have reason for gratitude to the medical services and that the surgeons of both wars can congratulate themselves on having carried out their tasks efficiently and well, though those of the 1939-45 war can pat themselves on the back at having obtained a lower mortality largely, I think, owing to the better conditions under which they worked and the better material they were called to work on.

I have made no attempt to deal with the vast routine surgery of civilian type, the hernia, acute appendix, perforated ulcer, varicose veins, piles, hammer toes and internal derangements of knee, which make the majority of the war surgeons' task, for these are the same abroad and at home, in war and in peace, and differences in results arise from personal variation in surgical skill and experience and the septic or aseptic conditions under which these operations are performed.

RICHARD OWEN

RICHARD OWEN was born on July 20th, 1804, at Lancaster and received his early education at the Grammar School in that town. When he was 16 he was apprenticed to Leonard Dickson of Lancaster, Surgeon and Apothecary, subsequently serving two other Lancaster surgeons before he matriculated at Edinburgh University in 1824. At Edinburgh he studied under John Barclay and it was on Barclay's advice that he transferred to St. Bartholomew's early in the following year. In London he studied under Abernethy who, as President of the College of Surgeons, was much concerned at the neglect of John Hunter's specimens, recently handed over to the care of the College. It was Abernethy who insisted that his pupil should undertake the arrangement of the collection. In 1827, Owen started on this laborious task under the guidance of William Clift who was appointed Conservator. Two curious coincidences now played a strange part in shaping Owen's career. In September, 1827, Clift's daughter fell from a step-ladder and Owen, called to attend her, fell in love with his patient. In September, 1832, Clift's only son—and his appointed successor—fell from a cab in Chancery Lane and Owen, on duty at St. Bartholomew's, attended him during the few days he lived after the accident. On July 20th, 1835 (his birthday), Owen married Caroline Clift and in 1842 he became joint Curator and afterwards sole Curator of the Hunterian Museum until 1856, when he was appointed Superintendent of the Natural History Collection of the British Museum. It is to Owen that we owe the original catalogue of the Hunterian Collection, a monumental work without which the thousands of specimens would have been almost valueless from an educational point of view. This catalogue no man save Richard Owen with his unique knowledge of comparative anatomy, could have prepared and even in his hands the task could never have been completed save for the care and devotion given to John Hunter's collection by William Clift. Owen was knighted in 1884, and died at Sheen Lodge on December 18th, 1892.

Bust of Richard Owen recently presented to the College by Alfred F. Sotheby.

COUNCIL ELECTION—3rd JULY, 1947

Mr. R. J. McNeill Love was re-elected, and Mr. A. Lawrence Abel and Mr. J. B. Oldham were elected members of the Council for the period of eight years.

1,563 Fellows voted : in addition 6 votes were found to be invalid and 11 arrived too late.

The result of the Poll was as follows :—

Candidates	Votes	Plumpers
ROBERT JOHN MCNEILL LOVE	839	25
SIR JAMES WALTON, K.C.V.O.*	835	3
ARTHUR LAWRENCE ABEL	637	35
JAMES BAGOT OLDHAM, V.D.	629	31
Arthur Dickson Wright	609	14
Hubert Wallace Symons	557	21
Harold Clifford Edwards, C.B.E.	478	14
Louis Carnac Rivett	356	11
Mariott Fawckner Nicholls, C.B.E.	277	11

*Not eligible for re-election.

ELECTION OF PRESIDENT AND VICE-PRESIDENTS—10th JULY, 1947

Sir Alfred Webb-Johnson, Bt., was re-elected President for the seventh year. Sir Cecil Wakeley was re-elected Vice-President. Mr. L. E. C. Norbury was elected Vice-President for the ensuing year.

The Practical Course for the Primary Fellowship Examination is being held at the College throughout August. The College is closed for all other purposes during August.

DIARY FOR SEPTEMBER

Mon.	1	3.45	PROF. A. ST. G. HUGGETT—Physiological Adaptations in Pregnancy.
		5.00	PROF. R. WILLIS—Some Embryological Principles in Pathology (ii).
Tues.	2	3.45	PROF. F. G. YOUNG—Endocrines and Carbohydrate Metabolism (i).
		5.00	PROF. R. WILLIS—Some Embryological Principles in Pathology (iii).
Wed.	3	3.45	PROF. M. J. STEWART—Osteoclastoma and benign giant-cell synovioma.
		5.00	PROF. SAMSON WRIGHT—Pain (i).
Thur.	4	3.45	PROF. M. J. STEWART—Some aspects of lipoid pathology.
		5.00	PROF. SAMSON WRIGHT—Pain (ii).
Fri.	5	3.45	PROF. J. KIRK—The blood supply of the Brain.
		5.00	DR. KEITH SIMPSON—The Ultimate Pathology of Criminal Abortion.
Mon.	8	3.45	DR. L. E. GLYNN—Atrophy and Hypertrophy.
		5.00	DR. M. KREMER—Concussion.
Tues.	9	3.45	PROF. A. C. FRAZER—Fat Digestion and Absorption.
		5.00	PROF. D. F. CAPPELL—Rhabdomyoma.
Wed.	10	3.45	PROF. J. KIRK—Gross Anatomy of the Spinal Cord.
		5.00	PROF. J. HENRY DIBLE—Inflammation, tissue reaction, and repair (i).
Thur.	11	3.45	PROF. J. BEATTIE—The Autonomic Mechanisms of the Brain Stems.
		5.00	PROF. J. HENRY DIBLE—Inflammation, tissue reaction, and repair (ii).
Fri.	12	3.45	PROF. J. BEATTIE—Micturition and its disturbances.
		5.00	PROF. J. H. BIGGART—The Pathology of head injury.
Sun.	14	8.00	Informal Reception to Member of the International Society of Surgery on the occasion of the 12th Congress.
Mon.	15	3.45	PROF. F. G. YOUNG—Endocrines and Carbohydrate Metabolism (ii).
		5.00	PROF. J. H. BIGGART—The Pathology of Virilism.
Tues.	16	3.45	DR. R. G. MACFARLANE—Blood Coagulation.
		5.00	PROF. J. H. BIGGART—Some Modern Concepts in the Pathogenesis of Vascular Disease.
		8.00	Dinner to the Delegates and Members of the International Committee of the International Society of Surgery.
Thur.	18	8.00	Reception to Members of the International Society of Surgery.
Mon.	22	5.00	DR. A. W. ALLEN—Moynihan Lecture—Duodenal Ulcer.
Tues.	23	5.00	DR. F. H. LAHEY—Joll Lecture—Hyperthyroidism.
Wed.	24	5.00	PROF. W. E. GALLIE—Moynihan Lecture—Recurring Dislocation of the Shoulder.
Thur.	25	5.00	DR. E. A. GRAHAM—Lister Oration—Some Aspects of Bronchiogenic Carcinoma.
Mon.	29	5.00	PROF. HASSAN IBRAHIM—Hunterian Lecture—Bilharziasis and Bilharzial Cancer of the Bladder.
Tues.	30	5.00	PROF. H. WOOKEY—Hunterian Lecture—The Surgical Treatment of Malignant Disease of the Pharynx and Oesophagus.

THOMAS VICARY LECTURE

NAVAL MEDICINE IN THE AGES OF ELIZABETH AND JAMES

by

E. Ashworth Underwood, M.A., B.Sc, M.D., D.P.H., F.L.S.
Director of The Wellcome Historical Medical Museum

THOMAS VICARY, in whose honour this lecture was founded, had been serjeant-surgeon to four monarchs, and he died in the fourth year of the reign of Elizabeth. During the last years of his life a new spirit had been born in England—a spirit of adventure by sea and land, and of commercial rivalry such as England had not previously known. Vicary was the foremost surgeon of his time. In his life at the court and in his practice he must have known many of the adventurous spirits who were later to become the idols of the age. There is no record of his views on the diseases which afflict those who go down to the sea in ships, but we can surmise that he would have shown sympathy with the movements which arose later to ameliorate the lot of the common seaman.

The Political Background

The age with which I propose to deal is one of intense transition in politics, in religion, and not less in the scope and method of war. To each of these the historian gives its due, but it is seldom that the role of disease in determining the destinies of nations is given its rightful place. Henry VIII, in 1546—a few months before his death—had abandoned his war with France when a quarter of the whole complement of his fleet were so stricken with typhus and scurvy that the ships had become floating pest-houses. During the reign of Mary the country had become an appanage of Spain, and in the very year of the accession of Elizabeth Calais had been lost to the French as a result of the ravages of disease in our troops.

Elizabeth ascended the throne in November 1558 at the age of 25 years. She was faced with difficulties of the first magnitude. Though fortunate in the choice of her ministers, it was very largely to her education, her courage, and above all to her shrewd political sense that the success of her reign is due. At her accession the country was in no state to wage a foreign war, or even to resist an invasion. Guided by William Cecil she decided to adopt the Protestant religion, and from the very start she established a national state with a national church. At the start too she made friends with Scotland, and helped that country to find itself under John Knox. Her toying with various real and supposed suitors was a masterpiece of political adroitness. Though Mary Queen of Scots gave herself up to Elizabeth ten years after her accession to the throne of England, it was not until nineteen years later that Elizabeth—much against her will—gave in to the wishes of her subjects and consented to

the execution of the Queen of Scots. By this action Elizabeth made a final break with Spain inevitable. Philip had adopted a policy which was bound to lead to war—a policy of exclusion of foreigners from America and Africa. By giving secret encouragement to the acts of privateers Elizabeth was able to oppose Philip's desire to renew his sway over England without showing open hostility to Spain, and at the same time she encouraged the maritime spirit which enriched her treasury and bred the men who defeated the Armada. This naval victory over the forces of Philip enabled the young Dutch Republic to cast off the shackles of Spain, and helped to liberate France under Henry IV. Yet, though the defeat of the Armada in 1588 was the outstanding event, the war itself continued until after the death of Elizabeth in 1603. She had reigned for 45 years. At her death it was felt, as H. A. L. Fisher says, that she was " a great woman, proud, mettlesome, and preternaturally wise, and that her life was dedicated to the service and honour of her country."

Elizabeth bequeathed to her successor a navy which had proved itself repeatedly in action, and it was a great misfortune that this weapon fell into the hands of " the most thorough-going pacifist who ever bore rule in England." Though the men-of-war were gradually taken out of service, a semblance of the old activity was preserved under other forms. James died in 1625, and the period 1558-1625 is that which I attempt to cover in this lecture. During this period England found herself and Great Britain was born. The language of Shakespeare and of the Bible became the national tongue. Those who tried their fortunes at sea—gentry, yeoman or artisan alike—were imbued with the spirit of the age. It is no mere coincidence that during Lancaster's third voyage for the East India Company, two of Shakespeare's plays were produced on his own ship, the *Dragon*. Surely *Hamlet* and *Richard II* can never have been heard under stranger circumstances.

The Naval Background

Before I proceed to discuss the difficulties of the Elizabethan surgeon who chose the sea as a profession, or alternatively, was " commanded to prepare himself " for it, it is desirable to take a glance at the maritime life of the period, and to consider what manner of men they were whom the surgeon had to treat, the kind of ships in which he had to sail, and the growing traditions which formed the background of his daily life. As Markham says, " the foundations of our naval supremacy were laid in silence so far as posterity is concerned."[1] Over a century before our period starts a map of the coasts from England nearly to Cape Verde was drawn in London; it included the Azores. In 1480 Thylde, " the most scientific seaman of all England," sailed from Bristol to discover an island called Brazil, and failing to find land, he had to return. He thus preceded Columbus by 12 years in the search for the new world. In 1496 John Cabot sailed from Bristol, and discovered a land which is usually considered to have been Newfoundland, but which some think

may have been Labrador. Two year later he embarked on another expedition, the only record of which, in the form of a map on bullock's hide by Juan de la Cosa, now hangs in the navy office at Madrid. The company of Merchant Adventurers received its charter in 1505, and in 1530 William Hawkins embarked on his voyage to Guinea and Brazil. In 1553, five years before the accession of Elizabeth, Richard Chancellor had found his way to Moscow by way of the arctic seas, and the result was the formation of the Muscovy Company. Other nations had been equally active, and the voyages of Vasco da Gama (1498) and Magellan (1520) had widened the horizon and given a hint of " glittering prizes for those who had stout hearts and sharp swords." The hope which had inspired Chancellor did not die with his failure to find a North-West passage to Cathay. Gilbert, Frobisher and Drake successively failed to find this passage, and the commercial rivalry of the time forced the English to challenge the Spanish and the Portuguese on their own trade routes. From an early period their eyes were cast on the Moluccas and the Indies. In this they had also the Dutch as rivals, though, until 1609 at least, fortunately friendly rivals. In 1577 there appeared a new edition of Richard Eden's translation of Peter Martyr's *Decades of the Newe World.* This new edition treated of the East as well as of the West Indies. This was one of the chief factors in interesting Elizabethan merchants and seamen in the possibilities of trading expeditions to the Far East. Meanwhile, Drake had sailed from Plymouth at the end of 1577 in the *Pelican*, with four other ships. On entering the Straits of Magellan he changed the name of his ship to the *Golden Hind*, and in a voyage which lasted nearly three years he circumnavigated the globe. Trevelyan[2] says that the knighthood which Elizabeth conferred on him was the most important ever conferred by an English sovereign.

In all these voyages England found an admirable historian in the person of Richard Hakluyt. To the pages of his admirable work I am indebted for much of the material of this lecture.

England had had a royal fighting navy since the time of Henry VIII, and his two great ships, the *Great Harry* and the *Henry Grâce á Dieu* had seen much service against the French. Even after the death of Henry the naval tradition persisted. In 1552 the French Ambassador wrote that the English were fitting out " ung grand équipage de mer " of not less than twenty good ships.[3] A year after her accession Mary had 30 ships of war, but by May of 1554 they had been to Spain and many were so neglected that they were not even seaworthy. A few months later she completely stripped and unvictualled many of her ships in order to supply those of Spain.[3] This was the heritage on which Elizabeth entered, and it is typical that one of her first acts was to secure the safety of the Narrow Seas. Before she had been Queen a week she ordered Malyn, the vice-admiral, to collect as large a fleet as possible for the protection of trade, and for the exclusion of unauthorised persons from the Kingdom. Within two months of her accession the Duke of Norfolk was speaking

of "her Majesties' navy" in a letter to Cecil.[4] Throughout her long reign her interest in naval matters never wavered, and she was blessed with commanders such as Drake who established a complete understanding between the Royal Navy and the merchant adventurers.

Naval warfare at this period was revolutionised by the transition from oar to sail. For centuries the typical Mediterranean war vessel had been an oared-galley, usually with four men to each oar. Such a vessel could not be used on the open seas, and guns could be mounted on it only fore and aft. The Spanish were much better soldiers than they were seamen. In war at sea the galleys were used merely as floating platforms to convey soldiers to enemy ships. Grappling and boarding was the order of the day, and there were few to equal the Spaniards after this preliminary objective had been achieved. The English on the other hand had had to develop a type of ship which would withstand the storms of the Channel and of the Atlantic. Their great ships were distinguished by high castles fore and aft, and by a narrow open waist. By the time of Elizabeth the castles had become lower, and decks were being fitted. The ships of Henry VII were the first to be fitted with regular portholes.[5] The weight of arms was rapidly increased, and the great guns being now mounted amidships, broadsides became possible. It was thus the broadside which gave the English their advantage, and during all the great actions of the age the principle of the English admirals was to avoid being grappled and to fight at long range. The battle of Lepanto (1571), when Don John defeated the Turks in the Mediterranean, and the expedition of the Armada were practically the last occasions on which the galley was used to any extent in war.

Some indication of the size of the vessels in which the men of this period sailed may be given by particulars of the large vessels in the Royal Navy. The *Henry Grâce á Dieu* was probably of 1,000 tons; she carried 21 heavy guns and 700 men.[6] In the time of Elizabeth the ships were no bigger but they were more efficient. The *Ark Royal*, Howard's flagship during the defeat of the Armada, was of 800 tons: she carried 38 heavy guns and 400 men. Only two Elizabethan ships, the *Triumph* (38 heavy guns) and the *St. Matthew* (48 heavy guns) were of 1,000 tons. Each carried 500 men. Most of the Elizabethan ships of the line were between 200 and 700 tons, with complements varying from 100 to 350 men.[7] By contrast, the *Royal Prince*, built in 1610, was of 1,330 tons: she carried 55 guns and 500 men. The *Sovereign of the Seas*, which later became the *Royal Sovereign*, was launched in 1637: she was of 1,700 tons, and carried 100 guns and 600 men.[8] These figures are themselves an indication of the type of battle risk which was run by the men. The increasing extent to which the men were used to work the guns, and the diminution of the numbers required as 'soldiers,' led to a greater number of casualties due to round shot and splinters than would have been possible in the days of Henry VIII. By the time of the Tudors the powder for the charge was loaded in canvas bags for the larger guns, and in paper cases for the smaller

guns.[9] Many serious accidents were thus avoided. In Elizabeth's time the complement of the regular fleet was about 7,000 men; by the time of the Stuarts it had fallen to between 3,000 and 4,000.[10]

One further important event must be mentioned. As a result of the successful trading in spices which the Dutch were carrying on, and of their making a ' corner ' in the pepper market, the East India Company was formed on December 31, 1600. The Dutch welcomed the entrance of the English into this field, since it gave them good allies against the Portuguese.[11] There was no hostility between English and Dutch until after 1609. Sir James Lancaster was appointed " General " of the East India Company's fleet. I shall have something to say later regarding the medical importance of his first voyage in 1601.

Sickness and Mortality on Voyages

Before discussing the conditions with which the Elizabethan sea surgeon had to contend, it would be well to have a general picture of the effect of these conditions. Such a picture is given in graphic language by the Lord High Admiral, Lord Howard of Effingham, in a letter written to Burghley a few days after the defeat of the Armada. Howard says[12]: " Sicknes and mortallitie begin wonderfullie to growe amongste us . . . the *Elizabeth*, which hath don as well as eaver anie ship did in anie service, hath had a great infectione in her from the beginning soe as of the 500 men which she carried out, by the time she had bin in Plymouth three weeks or a month there were ded of them 200 and above, soe as I was driven to set all the rest of her men ashore, to take out the ballast and to make fires in her of wet broom 3 or 4 daies together, and so hoped therebie to have cleansed her of her infectione, and thereuppon got newe men, verie tall and hable as eaver I saw and put them into her; nowe the infectione is broken out in greater extremitie than eaver it did before, and they die and sicken faster than ever they did, soe as I am driven of force to send her to Chatham . . . Sir Roger Townsend of all the men he brought out with him hath but one left alive . . . it is like enough that the like infectione will growe throughout the most part of the fleet, for they have bin soe long at sea and have so little shift of apparell . . . and no money wherewith to buy it." Such was the condition of the men who had just saved their country by one of the most decisive of all naval victories.

Sir Francis Drake was one of the greatest of all commanders, not only because of his superb seamanship and his fighting ability, but also because of the personal attention which he gave to the health of his men, making regular inspections and seeing that they were suitably clothed and fed. He was also in the habit of bleeding them before they ran into the great heat of the equator.[13] Yet in his voyage of 1585-6, out of 2,300 men Drake lost nearly 600 as a result of disease. In the expedition of 1589, out of 1,200 men nearly one half perished mainly from sickness and want of

food.[14] On Lancaster's first official expedition for the East India Company he had 680 men in four ships. Of these 180 were dead before the ships started on the homeward voyage, and at least a half of the total complement never returned to England. As we shall see, there were certain circumstances which made this voyage particularly favourable[15]. One further example may be given. James took from the Navy its privilege of capturing valuable Spanish prizes, and he did nothing in return to ameliorate the lot of the men. Hence pressed men were difficult to obtain. Raleigh wrote in the reign of James: " They go with as great a grudging to serve in his Majesty's ships as if it were to be slaves in the galleys."[16] In the fleet which went to Algiers one ship put ashore 92 sick men at Malaga at one time; while in 1623 the captain of the *Bonaventure*, which was almost a new ship, wrote that " of 160 men there are but 70 persons of all sorts that at present is either fit or able to do the least labour in the ship."[17] And this was in Home Waters, since the *Bonaventure* was serving on the East Coast! Sir Richard Hawkins thought that, in the course of his twenty years at sea, 10,000 men had died from scorbutic affections alone[18].

We have no detailed statistics of illness for this early period, but it may be assumed that there was no material change in the proportion of the different diseases between then and the middle of the 18th century. In 1760 James Lind gave details of 5,743 naval cases which had been admitted to the Royal Hospital, Haslar during a period of two years[19]. The following are the percentage distributions of the more important conditions which are given in Lind's data: Fevers (all types)—37·9; scurvy—19·6; consumptions—6·3; rheumatisms—6·1; fluxes—4·3; various cases classified under V.D.—11·8; pains or old hurts—1·4; cutaneous diseases—1·3*; ague and intermittent fevers—1·2; smallpox—0·9. The other diseases given in the list make very small contributions to the total. When we compare this list with those diseases to which Woodall gave prominence in his 1617 treatise—*viz.* scurvy, fluxes and calentures—it may be said that there was probably no very great change. These then were the diseases of Elizabethan seamen *par excellence*—fevers, scurvy, consumptions, rheumatisms and fluxes. So far as scurvy was concerned, frequently a half, two-thirds, or even nine-tenths of the entire crew was affected. The State Papers say more about losses from disease than they do about losses in battle.

I have already directed attention to the large complement of men which was carried on an Elizabethan warship. The merchant ships were even worse so far as overcrowding was concerned. The commanders had to be ready for action against the Spanish and Portuguese at any time, and they might also have to fight against hostile natives. Hence the crews had to be far larger than were required for navigational purposes. Bulky

*The low incidence of skin diseases is remarkable, and agrees generally with the figure given by Blane (1780). These conditions were probably common, but the patients were not generally admitted to hospital.

cargoes had to be carried, and the space occupied by the guns was considerable. In any ocean-going ship of the time, therefore, the crews were badly overcrowded, and any disease associated with filth was liable to occur. Some authorities say that the 'gentlemen'—or officers as we would call them—showed disgust at the conditions of the crews, but did little to improve them. This was, however, certainly not universally true. As we have seen, Drake at least was most solicitous for the welfare of his men. The Elizabethan seaman had to be tough. As "North-West Fox" remarked: "For to keepe a warm cabin and lie in sheets is the most ignoble part of a seaman; but to endure and suffer, as a hard cabin, cold and salt meat, broken sleeps, mouldy bread, dead beer, wet clothes, want of fire, all these are within board."

Ship surgeons: Their qualifications, fitness and remuneration

From what I have said it will be obvious that there was an ever-present need for a surgeon on every ocean-going ship of any size—and this apart altogether from the casualties in battle. According to certain authorities[20] there was an organised naval medical service in 1512; and certainly a Cotton manuscript of that date indicates a division into a chief surgeon, eight chief assistant surgeons (chosen by the admiral), and all other surgeons grouped together. This sounds excellent, but it is doubtful whether the arrangement persisted. Henry VIII established the Navy Board which looked after the health of the men in peace time. In war time a Board of Commissioners for Sick and Wounded Seamen took over these functions[21].

The writings of William Clowes shed considerable light on the conditions and experience of the naval surgeons of the Elizabethan age.

William Clowes (1544-1604)[22] was probably the foremost surgeon of his age, and certainly few could have had a wider experience of the various aspects of a surgeon's calling. At 23 he was a surgeon in the British expedition to France under Warwick. He then served for a time in the Navy. At the age of 35 he was appointed to the surgical staff of St. Bartholomew's Hospital, and in 1581 he became full surgeon. Four years later he resigned this appointment and went to the Low Countries to serve under the Earl of Leicester. In 1588 Clowes was admitted an assistant on the court of the Company of Barber-Surgeons, and immediately afterwards he served in the fleet which defeated the Armada.

In 1588 Clowes published *A Prooved Practise for all Young Chirurgians* in which he has much to say against the quacks of his time. One quack had approached "two simple fellowes, who were surgeons of two ships," and had written in their book of secrets particulars of a certain pill, supposed to be good for all diseases. Of the quality of the service given by surgeons pressed for the Navy, Clowes has this passage:

> "And what shall be sayd to some, which not long since have beene commanded to prepare themselves, and with all speede to serve her Maiesty in the Warres, then presently with many solemne circumstances,

did desire to be excused, protesting, that they had no knowledge in Surgery, but onely, for the drawing, and stopping of a tooth, letting of bloud, or for the cure of the french Pocks, and thus they did playnely throw all their skill in Surgery flat to the ground, which a little before shined most brightly in the eyes of many. But this I say is well knowne, let the service be once furnished with sufficient Surgeons, which oftentimes is very hard to do, then they begin to shake their chaines, and keepe a stirre, that they can cure that which all the best Chirurgions in London or elsewhere do forsake, but what manner of curing they use, I may not speake that I knowe."[23]

In a commendatory letter to Clowes on his work an anonymous friend gives other aspects of the character of many naval surgeons of the time. This passage is as follows:

"Surely the want of that knowledge in many sory Surgeons which in this booke is manifested unto us, hath cost many a poore Souldyer full deere, and hath made that stick by many Mariners, which they shall never be able to clawe off whiles they live. For when they have been any way maymed or indangered with losse of life or limme, then comes the bare singlesoled Surgeon, as he rightly tearmeth them, and what to do by arte knowes not, yet something he must attempt, treading in his old cowpath, as though he were healing a broken head, or plastering of a kibed heele, having one or two boxes of green Salves, with a plaster of Diachilon, and a greene grasse Melilot, with their motheaten Mussilage, and these are good forsooth for all sores, and so committeth the health of the patient to the mayne chance, a miserable thing, that warlike men should first fall into the hands of men, and afterward to be as it were massacred by such ignorant beasts. But that they may leave their brutish ignorance, and theyr savage cruelty, let them reade over if so be they can, this directive agayne and agayne, and if they be not tootoo sottish, they shall fynde theyr judgement amended, theyr wittes sharpened, theyr practise corrected, and theyr fingers directed, poynt by poynt, from the beginning of the cure, till the finishing thereof."

This jibe at the ignorance and the sottishness of many of the naval surgeons of the time is confirmed from other sources. In another passage Clowes complains of the want of surgeons caused by the flourishing practice of many untrained women. "For it is come to passe," he says, "at this day, that very fewe men being of any credite or account, that hath brought up his sonne in learning, the which is greatly to be required in a good Chirurgeon, but he refuseth to put him to be an apprentise unto the Arte of Surgerie. And why? Because there are in these dayes, in towne and countrie, such a number of abusers that practise Chirurgerie, which are the onely doers and cause of all these evills."

In 1588 four physicians were appointed to supervise the health of the fleet—just before it sailed to meet the Armada. These were Dr. William

Gilbert, Dr. Roger Marbeck, Dr. Browne and Dr. Wilkinson.[24] The first was of course Gilbert of Colchester, who subsequently wrote *De Magnete*, and founded the science of electricity. Roger Marbeck was a well-known physician of his day: eight years later he accompanied Essex on the expedition to Cadiz. These four doctors were instructed "to put themselves presently in a readynes to goe downe to the Navye, and to carry with them a convenyent quantytie of soche drogues as should be fyt for medycine and cure."[25] We may assume, however, that these four men would act more in a consultant and advisory capacity, and that their work bore little direct relation to that of a ship's surgeon. As they were appointed to Admirals' retinues, their skill and their medicines were probably intended for the senior officers.

In 1594 Elizabeth sent a fleet to blockade Brest, which had been occupied by the Spaniards. Sir Martin Frobisher commanded the sea forces. During the action he received a ball in his side. The wound was not in itself very serious, but it was made so by the inexperience of the surgeons. Although Frobisher brought his squadron back to England, he survived only a few weeks after his return.[26] Towards the end of the reign of James there were frequent complaints of the low standard of efficiency of the surgeons. The Company of Barber-Surgeons attributed the general disinclination of the more efficient surgeons to serve in the Navy to the fact that the pay was low, the life hard, and to the inadequacy of the allowance for the medical chest.[27] However, there are cases where the crews of ships refused duty if they did not have a surgeon, and in many ships the surgeons were certainly held in high regard.

The tracts of Admiral Sir William Monson bring me to the mention of the surgeon's mate. Monson, writing towards the end of the reign of James, gave the following definition of the duties of the medical personnel of a ship:—

> "*A Surgeon.* He has his mate; they are both exempted from all duty but to attend the sick and cure the wounded. There must be trial of his sufficiencie by certificate from able men of his profession: his chest must be well furnished both for physic and surgery, which should be viewed before going to sea, by men of skill. The surgeon is to be placed in the hold, where he should be in no danger of shot; for there cannot be a greater disheartening of the company than in his miscarrying, whereby they will be deprived of all help for hurt and wounded men." (The position of the surgeon's mate is not defined.)

It will be evident that much of the point of the suitability or otherwise of the medical personnel of the navy turned on the wages which they received. There is no doubt that there was a marked increase in the cost of living during the second half of the 16th century.[28] For example, the price of a pig or a goose had risen from 4d. to 12d. between 1565 and 1581, and in the same period a capon had risen in price from 3d. or 4d. to twice or thrice that sum.[29] There had been a corresponding increase in wages

generally. In 1557 infantrymen received 6d. a day, and cavalrymen 9d. a day; but it was proposed to raise these to 8d. and 12d. respectively.[30] From 1563 to 1588 common seamen received 14s. a month—or 6d. a day. A surgeon during that period was paid 1s. 6d. a day, or £2 2s. a month. By 1626 the pay of a surgeon in the fleet was fixed by the Navy Commissioners as £1 10s. a month, irrespective of the number of men serving on his ship; and by the same ruling the monthly salary of the surgeon's mate was fixed at £1.[31] In this scale the surgeon came below captains, lieutenants, masters, pilots, masters' mates, the higher grades of boatswains, pursers, gunners, and carpenters; they came above quartermasters' mates, carpenters' mates, cooks, trumpeters, drummers, etc.[32] "A little more than kith and less than kind"! The allowance for a surgeon's chest worked out at about £20, and was generally considered insufficient. Abuses were rife, and there was often complaint by the surgeons regarding the quality of the materials supplied. At Chatham dockyard a dockyard surgeon received £13 6s. 8d. a year.[33] Of course, a surgeon in the fleet at that time always had a chance of good prize money. Monson[34] laid it down that goods taken from an enemy were to be divided into three parts, the ship taking one part, the victeraller a second part, and the ship's company the third—"the Lord Admiral to have the tenths of all." In the division of the third part which went to the ship's company the surgeon took 5 shares and his mate 4 shares. The captain had 10, the master 7 or 8, the lieutenant 7 or 8, and the mates, the gunner, the boatswain, the carpenter, the trumpeter and the quartermaster received the same as the surgeon.

In addition to his duties in treating the sick, the surgeon was also supposed to inspect, along with the first lieutenant, the food, storerooms, living spaces, and the galley. He was also supposed to be present at all floggings.[35]

In the service of the East India Company matters were rather different. In 1582—18 years before the actual formation of the Company—an expedition to Cathay and the East Indies was financed by a number of gentlemen, one of whom was the Earl of Leicester.[36] The fleet consisted of four ships, led by the *Leicester* galleon, with Luke Fenton as captain and admiral, and with William Hawkins as chief officer. The expedition was a failure, and never got further than the Atlantic. The names of the surgeons who served in this voyage have been preserved. They were John Banester in the *Leicester*, Lewis Attmer in the *Edward Bonaventure*, and Robert Myssenden in the *Francis*. In the short period during which it was at sea the *Leicester* lost 45 men—including those who died of wounds and four who were drowned—out of a total complement of 125. Banester made a report to Leicester during the voyage on the health of the crew. John Banester (1540-1610) was a friend of Clowes and one of the foremost surgeons of the age. He later served in Leicester's expedition to the Low Countries, and he was the author of well-known works on surgery.

In Lancaster's first expedition for the East India Company in 1601 each ship had "surgeons twoe and a barber." The surgeon to the *Red Dragon*, Lancaster's flagship, was Ralph Salter, and he was allowed £32 for the furnishing of his chest. The chief surgeons of each of the other three vessels were James Lovering, Christopher Newchurch and John Gammond. It is interesting to note that in October, 1607, George Sheather was 'entertained' as surgeon's mate for the fourth voyage, and being found incompetent, was discharged before the fleet sailed. This is an indication of the care with which the Company selected their medical personnel. The impression is given that medical work was generally on a rather higher standard in the service of the East India Company than in the Royal Navy. The names of quite a number of the surgeons in these early voyages of the East India Company are known, but none is important in any other connection. We pass them by in silence, but in honour.

John Woodall

It is possible that, could John Woodall choose the department of medicine with which his name would be chiefly associated, he would select his services for the East India Company.

Born about 1556, Woodall was first a military surgeon, and he then resided in Germany and travelled in France and Poland for some years. In 1599 he was admitted as a member of the Company of Barber-Surgeons, of which he became Master in 1633. During the last 27 years of his long life Woodall was surgeon to St. Bartholomew's Hospital. When the East India Company was reorganised into a joint-stock concern in 1612, Woodall was appointed its first surgeon-general.[37] In that office he continued for nearly 30 years. Woodall threw himself into this work with enthusiasm. It is doubtful whether he ever sailed in a voyage of the Royal Navy, but he certainly had several voyages in ships of the Company.[38]

In 1617, after five years in office as surgeon-general, Woodall published a manual for the use of surgeons' mates, in which he embodied all his rich store of practical wisdom. This was: *The Surgions Mate, or a Treatise Discovering fathfully and plainely the due contents of the Surgions Chest, the uses of the instruments, . . . the cures of the most frequent diseases at Sea.*

This book was the first treatise on naval medicine. It was dedicated to Sir Thomas Smith, Governor of the East India Company. Woodall's high sense of the duties and responsibilities of his office comes out in his dedication when he says:

> "I have thought it a part of my duty in the place I have undertaken, according to that talent of knowledge where with God hath'inabled me, to give some directions for the weaker sort of such Surgions, that they may the better be able to undertake their charge, and also to

understand the true contents of their Chests, and profitably to practise as occasion shal require."

The same high principles are seen in his general description of the duties of a surgeon's mate, which he divides as follows : Firstly, his duty to God. Secondly, his duty to the chief surgeon, " towards whom he must be careful to behave himself wisely, lovingly, and diligently." Thirdly, his duty to the crew and his patients : he must visit *daily* the cabins of the men to see who hath sickness or imperfection, and to prepare dressings and instruments. Fourthly, his duty to himself. The surgeon's mate goes to sea for gain. Therefore, he must be diligent, watch all cases carefully, and keep a journal. He should read much in surgery and in physic.

The first part of this book sets out the instruments in the surgeon's chest, and describes their use. Then follows a materia medica. Next comes a section dealing with the chief diseases and their treatment. Finally, there is a section dealing with salts and their virtues, on sulphur and mercury. As a sort of appendix to the book there is an excellent list of alchemical characters and their interpretations, and on the lighter side Woodall includes a number of verses which give us some insight into his character. Almost throughout the book he refers to the surgical operator as ' the Artist.'

In 1628 Woodall published: *Viaticum, being the Pathway to the Surgions Chest*. It contains a list of instruments and directions for the treatment of surgical cases. It was republished in 1639 as a sequel to an enlarged edition of *The Surgions Mate*. This enlarged edition contained also treatises on the plague, and on gangrene and the technique of amputations. Woodall died in 1643, probably at the age of 87.

Naval Surgery

During the period with which I am dealing surgery at sea did not differ very widely from surgery ashore. Both were rough and ready, and in both cases the patient was operated on or treated in conditions which we should consider deplorable. Accidents were frequent, and often serious. Falls from the yards were quite common ; crushing of the limbs from falling gear and fractures and dislocations through slipping on deck were also met with. Sometimes a gun became loose during a rough sea. Such a dramatic incident was described by Victor Hugo in *Quatre-Vingt Treize*. These were all non-battle accidents. In battle the risks were greatly increased. It was not so much the actual risk of the individual being hit by a great shot or a musket ball. Infinitely greater was the risk of splinters, which flew widely through the ship when a great shot pierced the side.

The work of William Clowes, to which I have already referred, was a case book rather than a surgical treatise. Nearly all the cases which he describes are gun-shot wounds. He starts off with the treatment of burns due to gunpowder—which must have been a common accident. The

cases must have been carefully selected by Clowes as being particularly dramatic and instructive. Many would certainly have been interesting and difficult cases centuries later. In one case he describes the cure of a gunner who had been wounded in the abdomen. Though the intestines were intact, the omentum was hanging largely out of the wound. Clowes ligatured the omentum close to the wound, excised the distal portion, and cauterized the stump. Further treatment was followed by complete cure.

It is interesting to note that a third enlarged edition of Clowes's book appeared in 1637, thirty-three years after his death.

The surgical portions of *The Surgions Mate* show that Woodall was more familiar with the requirements of a text book than was Clowes. Woodall gives some very useful hints on amputations. He deprecates amputation through a joint, and emphasises that the Artist should avoid amputation whenever possible.[39] In fact, he is against unnecessary surgical interference at all times. He says: " For many Surgeons never thinke they have plaied the workmen till indeed they have made worke: Some by error for want of judgement, others for base lucres sake, prolonging and agravating with things not only contrary, but also dangerous to nature oftentimes. . . . I wish rather a Surgeon should heale gently, yea though hee should hazard the breaking out againe of the griefe. . . . These and the like grosse errors, unexcusable before God and man, have brought to the Arte a scandall, and a sensible feeling of want upon many vertuous professours thereof."[40]

Medical and Surgical Chests

The illustrations of the surgeon's chest which are given by William Clowes are artistic and interesting, but of no value in indicating the contents. The most complete description of a surgeon's chest is that given by Woodall. In it he sets out the names of about 80 instruments or appliances which should be in the chest, and follows this with a very complete materia medica. In his description of the uses of the various instruments he suggests that it is better to wait before using the incision knife, and he says that the trepan is used far too much. His drugs include Mithridate of Democritus, Andromachus treacle, the Diatesseron of Mesuë, and Elephant's tooth. It also includes china-root, which was formerly much used for the treatment of syphilis, and on which Vesalius wrote a famous treatise.

There are in the Wellcome Historical Museum two contemporary chests which are of some interest.* The first is a case of instruments for amputation and trephination which was formerly in the collection of Dr. Hamonic of Paris, and which was described by him.[41] The case and instruments date from the beginning of the 17th century. The case bears the initials " A.P." Hamonic discusses the possibility of the case having belonged to Ambroise Paré.

* These chests were shown after the delivery of the lecture.

The other case is a rare Venetian naval medicine chest of the 16th century. This chest is most interesting in that nearly all the boxes are clearly labelled, and the original drugs are not infrequently present. The contents include such interesting substances as terra sigillata, Venice treacle, mithridate, extract of ivory, horn of the unicorn, bezoar stone, oil of the viper—and even tooth powder!

Infectious Diseases

Fevers of one type or another were so common in the Elizabethan age that it would be impossible to deal even briefly with their relation to naval medicine in the course of this lecture. Plague outbreaks were not infrequent, and the disease must have been well-known to sailors who visited the East. Yet there are relatively few descriptions of outbreaks on ships which can be definitely ascribed to this disease.

An extraordinary occurrence was supposed to have taken place during the expedition of Wimbledon to Cadiz harbour in 1625. Finding that the enemy had retired into the inner harbour, the English fleet left to look for the treasure fleet from South America. Wimbledon soon found that his ships were foul and leaking, and that the crews were dying rapidly from disease. The story is told that, when he found 'a plague' breaking out on certain ships, Wimbledon had the sick distributed through the fleet, two to each ship, in order to prevent any of the ships from being short-handed. This story is not corroborated. However, whatever the circumstances and whatever the disease, the ships were too weak to make their home stations. The *Anne Royal* had 130 dead and a further 160 sick out of a crew of 350.[42]

Typhus is often confused with other fevers in interpreting the records. An interesting example of this is provided by the illness which occurred in the fleet after the defeat of the Armada. I have already quoted Howard's letter to Burghley on this outbreak. Oppenheim[43] points out that Howard in a letter to Walsingham complained of the sour beer which had been served out to them, and as he says, " nothing doth displease the seamen more than sour beer." Oppenheim considers that, in the light of all the events, the illness was probably an acute enteritis. Laughton[44], from his detailed study of the State Papers dealing with the Armada, shows that an illness of a similar type had been prevalent in the fleet even before the action with the Armada. He shows also that the ships which were commanded by old and experienced salts suffered comparatively lightly. Further, the ships which suffered most heavily were commanded by young men who were splendid fighters, but who had had no experience of keeping a ship clean. Laughton concludes that the disease was typhus.

The 'fluxes' were frequent, and, in foreign waters at least, were probably bacillary dysentery. Woodall gives considerable space to the treatment of these conditions.

A condition which causes much confusion is the 'calenture' of the naval writers. The Spanish word *calentura* means simply a heat or fever, and in the 18th century the English form was used for fevers in general. Singer thinks that the condition was probably heat-stroke or sun-stroke.[45]

It is strange that in the writings of the Elizabethans and early Tudors there are very few descriptions of conditions which might have been caused by pulmonary tuberculosis. Considering the overcrowding of the ships the disease must have been quite common.

I should like to call attention to the small work entitled, *The Cures of the Diseased in remote regions . . . incident in Forraine Attempts, of the English Nation.* This work was printed in 1598, and the only copies known are in the British Museum. It was reproduced in facsimile by Professor Singer in 1915. The author is given as "G.W." and Singer shows that this was George Whetstone, the Elizabethan poet and swash-buckler. Whetstone deals with the calenture, taberdilla (probably both typhus and yellow fever), dysenteries, erysipelas, and scurvy.

Sick Bays and Hospital Ships

There are few data on this subject for the period which we are considering. Oppenheim[46] says that no special provisions were made on men-of-war for the sick or wounded sailor. If the ship went into action he was placed in the cable tier or laid upon the ballast, as being the safest places. I have already mentioned Monson's direction that the surgeon was to work in the hold, where he would be less liable to be disturbed by shot.

The earliest hospital ship in the English or any other navy was the *Goodwill,* which accompanied the fleet to Algiers in 1608. However, she was afterwards "commanded for other purposes," and the invalids were thrust ashore to fare as well as they could in a Spanish port.[47]

We do not find a hospital ship again until 1654 when there was one at least in the fleet of Admiral Penn in the West Indies. Dr. Paul Delaune was the Surgeon of that ship. There may even have been two such ships in this expedition since Adjutant-General Jackson was sentenced "to be made a Swabber to keep the Hospital Ships clean for the Health of those who by his evil conduct and cowardice were wounded."[48]

During the early part of the reign of Elizabeth the disabled sailor was passed to his own parish. Preserved in the British Museum is a licence granted to William Browne of London to beg in churches. Browne had been wounded in 1588. The licence is dated 1590, and is to remain in force for one year.

In 1590 the Chest at Chatham was established. This was a scheme for mutual aid financed voluntarily by small contributions from every man and boy in the navy. It was not until 1829 that the stoppage of sixpence

a month from a seaman's wages was discontinued, but the chest itself and its contents had previously been transferred to Greenwich Hospital.[49]

Naval Hygiene

The gross absence of hygiene in ships of the Elizabethan age was the result partly of overcrowded conditions, and partly of the ignorance of the age and the official orders to which it gave rise.

In Butler's *Dialogues* the Admiral talks of " the over pestering of ships with soldiers and passengers, and especially when they are to pass upon long voyages, into hot countries ; . . . yet in voyages of length, especially to the southwards, I shall never advise a less allowance in proportion of room, than of two ton for every man ; and especially if they be mere landsmen, unused to the sea, who through their sea sickness and nastiness procure many infectious diseases as well to themselves as all that sail with them."

It seems that during this period an attempt was made to mitigate the overcrowding, since defended cabins appeared fore and aft on many of the ships ; and in others cabins were also fitted up in the waist. This attempt to provide more accommodation did not meet with the approval of Raleigh, who said of cabins : " They are sluttish dens that breed sickness in peace, serving to cover stealths, and in fight are dangerous to tear men with their splinters."[50]*

The hammock had been in use unofficially since the time of Columbus,[51] but it was introduced officially in the English Navy only in 1597.[52] It is said that Elizabeth halved the allowance for the proposed hammocks when she learned that the crews slept in alternate watches.

Ventilation was always difficult in ships of the 16th and 17th centuries, since the interior communicated with the outside air only through the gunports and hatches. About the time of the change from oar to sail, windscoops or windsails were adopted. These light canvas screens used to direct the air downwards were useless in a calm or when the hatches were battened down.[53]

Clothing was a difficult problem. Since no official uniform was provided disease was liable to break out with each new batch of pressed men. In 1623 the introduction of the slop-chest did something to mitigate this evil. There were no arrangements for drying clothing, and an old code of naval laws laid it down that any seaman who undressed himself while at sea was to be ducked three times from the yard arm.[54]

It was an old established custom that tubs of urine had to be kept in readiness to quench fires, and Monson gives an instruction to this effect. No reason is suggested why urine would be more efficacious for that purpose than sea water.[55]

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* Surgeon-Commander J. J. Keevil informs me that the same criticism was made by many naval officers during the recent war, when, apart from fire risk, wooden partitions were unpopular because of the danger from splinters.

The ballast consisted usually of gravel, and speedily became very foul as a result of the soaking from bilgewater, the seeping of beer, and the general waste from the ship. It is said that in the French and Spanish navies dead men were often buried in the ballast until the ship reached port. Sir William Wynter in 1578 advocated the use of stone ballast instead of gravel, but his suggestion was not generally adopted, and it was not until about 1800 that pig-iron was substituted for gravel.[56]

All this was very important, since the 'cook-room' was a solid structure of bricks and mortar, situated in the hold. This made the ship hot, and there was a risk of fire. In the expedition of 1590 Hawkins's flagship, the *Mary Rose*, had the cook-room removed to the poop, but this example was not followed. Even as late as the 18th century, the cook-room was often in the hold.[57]

Drunkenness was the rule rather than the exception, and there were frequent complaints of sour beer, and of the men having to drink the water which they carried with them. As Sir Thomas Overbury says: "The saylor . . . is part of his own provision,—for he lives ever pickled."

The water which was carried was often in a foul state, and an order which instructed the crew to fill the water casks with sea water after they had been emptied had some good effect.[58]

In the Wellcome Museum there is a unique broadside written by Sir Hugh Platt (1552-1608). Platt was a well-known writer on agriculture, and he published *The Jewel-house of Art and Nature*, *Delights for Ladies*, and other works. In these he dealt with methods of preserving meat and other foodstuffs, and a method of keeping lemon juice fresh by the aid of salad oil. In the broadside to which I refer he deals with the preservation of beverages, distilled water, medicines, and lemon juice by aid of the *ignis philosophicus*.*

Scurvy

I conclude with a brief account of the condition which is *the* sea disease, and which for centuries caused such heavy mortality among the sailors of all nations—scurvy. The disease had long been known in war, especially in besieged cities, but it was with the advent of the great voyages that its powers really made themselves evident.

Scurvy was apparently first met with in the voyage of Vasco da Gama to the Indies by the Cape of Good Hope in 1498, during which he lost 55 men in a short time. In the voyage of Magellan it was also met with; there were 19 deaths and about 30 others were affected.

In 1536 Jacques Cartier, during his second voyage to the St. Lawrence, had a harrowing experience of this new disease. His description of the symptoms is typical of the accounts which were later collected by Hakluyt. Cartier says:

> "The said unknown sickness began to spread itself amongst us after the strangest sort that ever was either heard of or seen, insomuch

* A description of this broadside will be given in a separate communication.

as some did lose all their strength, and could not stand on their feet; then did their legs swell, their sinews shrink as black as any coal. Others also had their skins spotted with spots of blood of a purple colour; then did it ascend to their ankles, knees, thighs, shoulders, arms, and neck; their mouth became stinking, their gums so rotten that all the flesh did fall off even to the root of the teeth, which did almost all fall out. With such infection did this sickness spread itself in and thru ships that about the middle of February, of a hundred and ten persons that we were, there were not ten whole; so that one could not help the other . . . There were already 8 dead and more than 50 sick, and, as we thought, past all recovery."

Cartier was so impressed that he had a post-mortem carried out on a man of 22. He says that they had the body

> " . . . ripped to see if by any meanes possible we might know what it was, and to seeke meanes to save and preserve the rest of the company: he was found to have his heart white, but rotten, and more then a quart of red water about it: his liver was indifferent faire, but his lungs black and mortified, his blood was altogither shrunke about the heart, so that when he was opened great quantitie of rotten blood issued out from about his heart: his milt toward the backe was somewhat perished, rough as it had bene rubbed against a stone. Moreover, because one of his thighs was very blacke without, it was opened, but within it was whole and sound."[59]

The relation of the lemon to the cure of conditions which were probably scorbutic was known from very early times, though there was no body of knowledge which might be considered as pointing scientifically to further enquiries. The first monograph on the lemon and its properties —the *De limonibus tractatus*—was extracted from the Arabic work on materia medica of Ibn-al-Baitar (1197-1248) and translated into Latin by Andreas Alpagus. It was published at Paris in 1602. In it are discussed the virtues of the rind, the juice and the seeds. The author also discusses the method of preparing the syrup from the juice, and the virtues of the syrup. Scurvy is not mentioned by name, but lemon juice is recommended for certain symptoms, such as morbid conditions of the mouth.[60] Citrons and oranges appear to have been introduced into England in 1290.[61]

There is no mention of lemon juice in the medical books in use before the close of the 16th century. In dealing with scurvy in the 1588 edition of his work, Clowes refers to Wyerus, *De Scorbuto*. Wyerus says that the condition is due to deficiency of diet, and strongly recommends water-cress. The diet should be easily digested, and should have a " good juice some-what hoate, thinne, piercing, and clensing."[62]

Meanwhile, in 1593 Richard Hawkins of the *Daintie*, sailed from Blackwall in a voyage to the Straits of Magellan. Before they had reached the line the company began to fall sick of scurvy. Hawkins gave a magnificent description of the symptoms. At Santos in Brazil they obtained

200 or 300 oranges and lemons, but there were so many men sick that there were not more than three or four oranges for each patient. "Coming aboard of our ships there was great joy amongst my company, and many with the sight of the oranges and lemons seemed to recover heart. . . . It is the great and unknown virtue of that fruit to be a certaine remedy for this infirmity."[63] This account was written in 1593, but was not published until 1622, after the death of Hawkins. It is suggested that the virtues of the lemon were known to many other Elizabethan seamen—both from Hawkins and from their own experience.

I have already referred to the voyage of Captain Lancaster in 1601. He had scurvy in his fleet, and when Table Bay was reached Lancaster had to help his other ships with working parties, and to hoist out the boats for them. Lancaster had taken the precaution of carrying a supply of lemon juice with him on the *Dragon*. He gave three spoonfuls to each man every morning fasting, and by this means he cured those who had scurvy and prevented sickness in the rest.[64] From the writings of Renneville it would seem that the Dutch knew more about the use of the lemon than did the English at this time.[65] That a long voyage was possible about this period without much illness is shown by the log of John Conny, Surgeon in the *Peregrine* of London, which sailed in September, 1648, and did not reach a home port again until December, 1649. During the long voyage the only death was that of the Captain.[66]

There has been some discussion as to whether the Elizabethans and the Early Stuarts knew that lemon juice would *prevent* scurvy. On this hear Woodall, writing in 1617:

> "The use of the juice of lemons is a precious medicine and wel tried. . . . It is to be taken each morning, two to three spoonfuls, and faste after it two houres, and if you adde one spoonefull of *Aquavitae* thereto to a cold stomacke, it is the better. . . . *Some Surgeons also give of this juice daily to the men in health as a preventive, which course is good if they have store, otherwise it were best to keep it for neede.*"

It should be noted that in the First Letter Book of the East India Company there is a bill of loading which includes lemons.

All these happenings antedated James Lind by a century and a half. Richard Hawkins was probably the first English naval officer to use lemons deliberately in the cure of scurvy, and Lancaster was the first to use them for prevention. Woodall has the credit of being the first professional man to give his support to the lemon, both for treatment and for cure.

EPILOGUE

Thus ends our fleeting journey through this period of seventy years which laid securely the foundations of the maritime supremacy of Britain. Though in passing I may have given occasional hard knocks to the surgeons of the time, we must remember that in the records criticism comes out

more frequently than praise. As a body the surgeons were splendid men in action, and it was no fault of theirs if the problems with which they were faced were far in advance of the scientific knowledge of the time. Let us remember too the praise of Richard Hawkins, who in 1593 said of them :

> " In this Navigation, after our surrender, the Generall tooke speciall care for the good intreatie of us, and especially of those who were hurt. And God so blessed the hands of our Surgions (besides that they were expert in their Art) that of all our wounded men not one died, that was alieve the day after our surrendry, and many of them with eight, ten, or twelve wounds, and some with more."

Such were the men who helped in no small measure to lay the foundations of Britain's future pre-eminence in naval and military medicine.

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BLOOD TRANSFUSION AND INTRAVENOUS THERAPY

Post-Graduate Lecture delivered at The Royal College of Surgeons of England

on

24th April, 1947

by

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NOW THAT THE shouting of war has died down, it is possible to review some aspects of the many new facts concerning transfusion and infusion which were learned as the result of a large experience during the world struggle. In general, the indications for transfusion became more clearly defined, whilst the limitations of this form of therapy, as well as certain hazards, came to be appreciated.

Transfusion is essentially a replacement therapy ; it may be required to restore a deficient blood volume ; to restore oxygen-carrying power, which may have been acutely reduced by a sudden haemorrhage or have become deficient by more insidious processes ; to supply the many other elements to be found in blood, such as leucocytes, platelets, clotting factors, complement and specific antibodies, and, to overcome dehydration. Because the indications for transfusion are manifold, it is always salutary to consider for a brief moment before beginning the operation as to whether the fluid which is to be used actually contains the element which the patient requires. Choice of fluid is frequently governed by availability, but broad principles help to indicate whether the available fluid is likely to accomplish its purpose. For example, whereas a crystalloid solution is most valuable for overcoming dehydration it has only a temporary effect in restoring blood volume, for which a fluid containing a large molecule, such as a protein is essential. For restoring oxygen carrying power haemoglobin is required. The fluid most commonly used for transfusion is stored blood.

A service was established to meet the emergencies of war, and this has now been projected into the Regional organization of the forthcoming National Health Service. Stored blood is so readily available that one must be aware, not only of its virtues, but also of its limitations, so that convenience may not tend to outweigh the therapeutic ideal. Stored blood finds its best use in the treatment of the simple anaemia of acute haemorrhage. Here, it achieves the double function of restoring both blood volume and oxygen carrying power. Many other relatively simple anaemias respond favourably. But the endurance of stored blood in the circulation is mainly a function of its age, assuming that collection and storage have been carried out efficiently, and with an anaemia—where the maximum endurance is required, such as aplastic anaemia, fresh

blood must be regarded as more appropriate. If stored blood be used, it should be as young as possible. With modern technique for collection and storage, good results can be expected in most simple anaemias with blood not exceeding 21 days in age. But with certain of the more complex blood dyscrasias such as leukaemia, clinical experience has shown that fresh blood is superior. Furthermore, it should always be borne in mind that the only element of blood which is efficiently preserved is the red cell. Leucocytes degenerate and rapidly die; platelets disintegrate fairly quickly, whilst prothrombin, complement and immune bodies gradually decline. Fresh blood is required whenever it is desired to transfuse these more ephemeral elements. Fresh blood, citrated and transfused indirectly or transfused direct from a heparinized donor (1 mgm. per kg. of body weight) provides the ideal tissue graft and is required, from time to time, in preference to stored blood for the proper treatment of difficult medical cases.

Certain dangers associated with stored blood should not be forgotten. In order to be safe for use the blood should be collected by experts, who can reduce the contamination rate to a minimal figure. Even so, occasional bottles contain a few stray contaminating organisms. This is of small importance provided the blood be instantly refrigerated and be constantly maintained at 4°-6°c. up until the time of use. But once the restraint of refrigeration has been lifted, even a small contamination will rapidly multiply and may give rise to anything from a rigor to rapid death. Once stored blood has left the refrigerator, it should be used with as little delay as possible; it should not be allowed to remain for hours in a hot theatre; it should not be kept overnight for use the next day; and it should never be replaced in a refrigerator, having once been allowed to warm. Economy of this kind is dangerous and is very unfair to a subsequent user. Excluding disasters from incompatibility, the commonest cause of accidents with stored blood is a failure to observe these simple commonsense rules about refrigeration.

Old stored blood is also dangerous; it contains pigment and corpuscles which are rapidly destroyed in the recipient's circulation. A massive transfusion of old blood is the equivalent of an incompatible transfusion by reason of the pigment which is rapidly released and which gives rise to the same type of reaction and even death, as with intravascular haemolysis from iso-agglutinins.

Many anaemic patients are deficient in no more than oxygen-carrying power. The blood volume is normal, or sometimes excessive, and it is very easy to overload the circulation with a large-volume transfusion, more especially in chronic anaemic states where the cardiac muscle is impaired. In these circumstances it is a great advantage to transfuse a simple concentrate of red cells, rather than whole blood, of which the plasma merely adds to the volume of the circulation, and has eventually to be excreted. Concentrates of red cells can be prepared by centrifugalization, but a simple method, which has the advantage of avoiding

manipulation and contamination, is to store the bottle of blood in an inverted position and to transfuse only the lower half. Red cell concentrates have about double the capacity of whole blood for raising the haemoglobin figure.

Considerable misunderstanding exists as to the proper use for the blood substitutes which were developed for emergency work during the war period. The best-known substitutes are natural human plasma or serum in fluid form, and of limited stability, or as dried products stable for an indefinite period without the necessity for refrigeration. There are also large molecule-containing fluids, such as human albumen, gum-saline, pectin, isinglass, or the synthetic German product know nas Periston. The stability of these products renders them immediately available without an elaborate refrigeration service. This is of immense value when speed is essential, more especially in country districts. It is obvious that such blood substitutes have no oxygen-carrying power; their use is therefore limited to restoration of blood volume in cases of exsanguination, and particularly when the reduction in volume is due to plasma loss as with burns. The advantage of the large molecule is that the transfused fluid remains in the circulation so that the volume is permanently restored. This, of course, is the fundamental requirement when volume has been acutely and dangerously reduced by rapid exsanguination, as with those who are wounded or with women who suffer a severe post-partum haemorrhage. Provided that the volume of the circulation is promptly and adequately restored to a point where the circulation can function efficiently, very few die from haemorrhage. On the other hand, the use of the blood substitutes inevitably means that the circulating blood is diluted, and may be seriously lacking in oxygen-carrying power. It is for this reason that blood itself is superior to the blood substitutes, in that the former achieves a double object. Furthermore, there is little doubt that when the patient needs to be subjected to a severe operation or to considerable manipulation, following upon the transfusion, there is very much higher mortality if the oxygen-carrying power be seriously reduced. An anaemic subject is ill equipped to stand an anaesthetic, or further blood loss or the trauma of the operation itself. A sound rule is that when transfusion has to be followed by operation, the haemoglobin level should not be less than 70 per cent. of normal. This is usually achieved by a judicious mixture of plasma (or serum) and blood; equal amounts, if the blood loss has been of the order of five or six pints, and two of the former to one of the latter with lesser blood loss. At one time there was much controversy on the relative merits of blood and plasma. Extremists advocated the use of one or the other exclusively. The true answer, as usual, is intermediate; a judicious mixture of the two will achieve the desired object. One small advantage of using a proportion of plasma is that it is a peculiarly suitable fluid with which to begin a transfusion, on account of the speed with which it can be administered. Speed at the outset is often essential. When the oligaemia is due to

plasma loss, as in the case of burns, plasma is obviously superior to blood. Nevertheless, blood should not be withheld from a case of burns because no plasma is available.

It has already been stated that the crystalloid solutions, saline and glucose, find their main use in the treatment of tissue dehydration. They have only a temporary effect in restoring blood volume, but it is sometimes life-saving to exploit this temporary effect what time blood or some other large-molecule fluid is being obtained. Crystalloid solutions administered intravenously always carry the risk of pulmonary oedema especially when chlorides are used. Intravenous hydration should, therefore, only be used when the oral route, supplemented by rectal administration, if necessary, is impossible. Certain cases, such as with penetrating wounds of the belly, require to be hydrated by the continuous intravenous method for several days. The daily requirement is 3-4 litres within 24 hours. The choice of fluid is important. Chloride should not be given in excess of chloride loss and in calculating the latter it is useful to remember that whatever volume of gastric juice is removed by suction contains about 1 per cent. of sodium chloride ; some estimate of the loss by sweating and urinary secretion has to be added to this figure. A good clinical test for chloride sufficiency is a simple examination of the urine with silver nitrate. So long as chlorides are present in the urine, there is no serious body deficiency. But the reverse is not always true, in that patients with renal failure may fail to excrete chlorides. In general, the safest fluid for continuous intravenous hydration is isotonic (5 per cent.) dextrose ; a pint or so of isotonic saline may be substituted for the equivalent volume of dextrose, whenever indicated.

Successful transfusion therapy demands not only a rational selection of the fluid to be used, but also great clinical judgment in regard to the volume given and the rate of administration. Hard and fast rules are difficult to lay down and judgment has to be made according to the type of case, the age and general condition of the patient, the state of the cardiac musculature, the lungs and the kidneys and any peculiarities, such as an allergic tendency. For acute exsanguination, particularly in young adults, it is almost impossible to administer the first two or three pints at too fast a rate. Indeed, in certain war injuries, life has undoubtedly been saved by transfusing both arms at the same time as rapidly as possible. But once recovery of the circulation has begun, the rate needs to be judiciously slowed in relation to the response as judged by the recovery of the blood pressure and pulse rate. In less acute cases, a reasonably fast rate and later 20-40 drops a minute is appropriate. With impaired cardiac musculature, the maximum use should be made of the small volume transfusion given by red cell concentrates.

In certain states, transfusion is either contraindicated or must be pursued with great caution. Penetrating wounds of the chest and many other pulmonary conditions, especially blast injuries, require great judgment. The general condition is usually made worse by transfusion. The same

applies to cases of fat embolism or states in which there is a mechanical impediment to the circulation, as with haemopericardium.

Transfusion reactions are relatively common when all grades from a slight fever to a severe rigor are taken into account, whilst disaster and death may follow careless work. From the clinical aspect, one often has to make a rapid decision as to whether a reaction is serious and dangerous or whether it can be disregarded. Pain in the back is probably the most important sign for suggesting a reaction due to incompatibility, in contrast to one caused by pyrogenic material or other foreign matter in the fluid which is being transfused.

Gross incompatibility is nowadays rare, in that the intricacies of the indirect and direct matching tests have been appreciated. At the present day no simple crude bedside test for compatibility is accepted, more especially when multiple transfusions or transfusions to women are contemplated. Avoidance of simple pyrogenic reactions is largely a matter of scrupulous technique in the preparation of solutions and in the cleanliness of apparatus. New rubber tubing, especially that which contains a high proportion of synthetic rubber is a common cause of rigor, unless the tubing has been previously cleaned of chalk and boiled for a period in 0.1 per cent. caustic soda. It is not generally known that about 10 per cent. of individuals cannot tolerate a fast rate of transfusion, to which they react with a rigor. Mere slowing of the rate will abolish a rigor originating from this cause.

The menace of infected blood has already been mentioned. Danger arises most commonly when refrigeration has been imperfect or intermittent. The common infecting organisms are *B. subtilis*, aerial coliform bacilli, *Pseudomonas pyocyanea*, *Staphylococcus albus*, and occasionally, a streptococcus. Of these, the aeri alcoliforms and *Ps pyocyanea* are extremely dangerous. These organisms have some power of slow multiplication, even at refrigerator temperature, and once the restraint is released may multiply with great rapidity. Transfusion of as little as 50ccm. of a heavily infected blood may be rapidly fatal. Unfortunately, an infection with these organisms does not reveal itself by visible haemolysis in the sample of blood.

Transmissible diseases include syphilis, malaria and infective hepatitis. The first two can be largely excluded by history and appropriate tests, whilst a week's storage at refrigerator temperature practically eliminates any chance of infection. There is, however, almost no safeguard against the transmission of infective hepatitis. The risk is small in the case of individual samples of blood, but is greatly increased with plasma or serum which has been derived from a large pool of donors. The present policy is to prepare plasma and serum from small pools.

The danger of old blood has also been emphasized; it is especially great in those who have been seriously injured. Such cases are potential candidates for renal damage, leading eventually to anuria merely by reason

of their injuries. The possibility of this complication is increased if the kidney be also called upon to excrete a large quantity of haemolysed pigment. Air embolism is an occasional cause of accident. It is due either to faulty apparatus, faulty needling or to allowing the level of fluid to fall below the exit tube, especially when positive pressure has been applied.

Taking into account all of these potential hazards, it must be agreed that transfusion is not an operation which should be lightly advised. With modern facilities and service there is some danger that the procedure may be too freely practised. There is little justification for transfusing when a short course of iron would achieve the same result, whilst a so-called "pep" transfusion, a common practice during the war, is usually a quite unjustifiable risk. The basic indications should always be borne in mind and proper thought given to such questions as choice of fluid and the volume and rate of administration.

THE REPLACEMENT OF SKIN LOSSES IN TRAUMATIC INJURIES

Surgery Lecture delivered at The Royal College of Surgeons of England

on

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by

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It is obvious that the title of this talk covers a field too vast to be dealt with in one paper. My remarks will be confined therefore to those methods of repair which are easily available and which can and should be used in cases of energency. In general this will mean the use of free grafts but when the indications for a more extensive repair are present the methods whereby this can be carried out will be mentioned.

The skin is not simply a cover or membrane which protects the underlying tissues against injury and infection and serves as a barrier against loss of tissue fluid. It is a highly specialized structure with many functions and it is obvious that it must be intact to work satisfactorily. It is the recipient pathway through which travels an unending stream of stimuli concerned with the maintenance of muscle and vascular tone. None of the many reflexes for which it is the receptor end can function unless the skin be intact and even then the presence of painful scars may be sufficient to produce serious local ill effects. One may see a damaged hand healed but showing two or three painful scars in the fingers. The hand as a whole will be cold and sweaty and its colour will vary from bright red to pale blue, whilst its functional value, even in its optimal state, is seriously diminished.

It is also true that even if the deeper structures have escaped initial damage their efficiency will be temporarily lost and possibly permanently decreased if the integument over them is not restored quickly and completely.

The methods whereby this repair is carried out will vary from the simple split grafts to the more complicated procedures required to transfer skin and subcutaneous tissue from elsewhere on the body. These methods will entail the use of flaps or tubed pedicles and are frequently time consuming and not therefore always available as the primary repair. They can always be used at a later date if they are necessary and they will be used much more readily and with much more successful results if the primary repair has eliminated infection, has avoided fibrosis and has preserved the function of the other structures in the affected area. It will be found therefore that the cases here illustrated are concerned chiefly with the use of free split skin grafts. In some instances their use

has been obligatory because of the size or the position of the lesion but in other instances they have been used as a temporary repair, i.e., split skin has been applied as a primary dressing. In yet a third group of cases they are the method of choice for the definitive repair.

Whenever split skin grafts are used there are several prime necessities. The first obviously is the availability of a suitable donor area. An intact thigh will provide sufficient skin for most purposes. The outer aspect is best used with the hip flexed and adducted and the knee bent. The antero-internal aspect may be used with the hip slightly flexed and externally rotated and the knee slightly flexed and it is helpful to have the thigh supported from beneath by an assistant. The least suitable area from which to cut skin on the thigh is the anterior aspect. Here the prominence of the femur prevents one from obtaining any reasonable width of flat surface from which to cut the graft. The flat surface itself is obtained by pressure with a small board held in the left hand. The cutting edge of the knife follows very closely and the actual cutting is done by an easy sawing movement; no real force is needed.

As an alternative to free hand cutting a Padgett dermatome may be used. In this case success is more dependent on the use of an efficient cement than upon the presence of a plane skin surface. The abdominal and chest walls become available as a source of skin and perhaps the chief value of the dermatome is the latitude in choice of donor area which it affords rather than any intrinsic merit in the graft it cuts.

The second essential for skin grafting is a dry and uninfected recipient area free from all tags of dead or moribund tissue. Infection in recent wounds is however more often an expression of indifferent surgery than of the magnitude of initial contamination. An essential prerequisite therefore to grafting of recent wounds is effective and complete debridement.

The third requisite for success in skin grafting is that the graft should be subjected to even pressure which is capable of being maintained for from two to ten days. Recently there have been many claims for various types of autogenous tissue glue, or mixtures of serum and thrombin. These substances have their value but they should not, at least for the present, be considered as more than adjuncts to the old method of pressure dressing. In most instances this pressure is obtained by an accurately made mould of cotton wool pressed firmly into position by a crêpe bandage. The requisite amount of pressure should be in the region of 30 mms. of mercury and in practice this is obtained by a firm dressing which is not tight enough to occlude the blood supply peripheral to it.

Now if these essential points can be fulfilled, how soon should skin loss be made good? The answer is as soon as possible, for the restoration of the loss will obviate infection, will eliminate fibrosis with its resultant dysfunction of underlying muscles and joints and will prevent distortion and limitation of movement by scar contracture. When bones are fractured or joints damaged the skin graft can be covered immediately

by the requisite plaster splint which may then be left in position as long as is necessary.

It may be worth while to consider the results of the immediate grafting of skin to various areas.

Scalping lesions are most frequently factory accidents and for obvious reasons usually occur in women. The initial injury frequently leaves the cranial periosteum intact though small flaps may be lifted from the bone and curled back. If nothing be done within the first 24 hours these flaps will retract still further and die, and infection will often result in secondary necrosis of the periosteum over the whole area. This leaves the outer table exposed and even with modern methods of treatment this condition

Fig. 1.—(A)

Avulsion of the scalp of six hours duration. If left untreated the areas of ecchymosis will probably ulcerate to expose bone.

Fig. 1.—(B)

Condition immediately after the removal of the first dressing one week later. The grafts were applied as strips to ensure accurate fitting and the scars between them can be seen.

will be present for many months before a satisfactory granulating base is obtained upon which a secondary skin graft can be applied. The immediate application of a split graft will avoid this complication and should result in complete epithelialisation in seven to ten days.

Lesions of the face

The commonest cause of major skin loss is probably a burn, and in this case, as in the others, operative restoration is desirable at the earliest moment. Treatment is therefore directed towards obtaining clean granulations as soon as possible. The dysfunction most likely to ensue

from failure to get an early skin cover is ectropion, and with this comes the attendant risk of corneal ulceration and perforation. Blindness is a heavy price to pay for failure to replace skin.

The technique of application of skin to the lid is a little different from elsewhere because pressure on the graft is most readily obtained by a mould of dental impression compound. A shallow marginal incision

Fig. 2.—(A)
Ectropion of old standing from a burn. Risk to the eyes is slight as only the lower lids are involved.

Fig. 2.—(B)
Replacement of the scar in the lower lids and left upper lid by free split grafts.

releases the scar and through it the lid is unrolled like a blind. Over-elongation of the lid is aimed at. The dental impression compound is shaped accurately to fill the defect. It is covered with the graft and held in position by sutures and a pressure bandage.

Lesions of the trunk

The commonest causes of extensive skin loss are either surgery or burns. Minor losses are less important because even if they are slow in healing dysfunction is unlikely and the destruction of small areas of skin on the body is less likely to lead to disturbance of sensation of vascular tone or of function, than anywhere else.

Skin grafts, however, are still the rule and particularly in small children, who are so prone to acquire extensive body burns through their clothes catching alight, the procedure may be life saving. The elimination of the raw surface alters the whole outlook of the case. Secondary blood changes do not occur, infection does not supervene and the child's condition is rendered infinitely less precarious.

The difficulty will often be that of obtaining secondary skin to cover the defect. Homografts may be used provided that it is clearly understood that their permanence can be measured in weeks only. This period,

however, is enough to allow regeneration of the skin in the original donor area so that at the second operation the same site can be used again.

Fig. 3.—A and B.

(A) Extensive body burns. Strip grafts were applied and (B) shows the result 12 days later. Additional grafting to cure contractures of the neck will be necessary.

Thighs

The thighs come in the same category as the trunk. The urgency is perhaps not quite so acute as elsewhere but early repair is still desirable particularly in the inguinal region. Contraction here or behind the knee may cause serious limitation of function in the joint and if this is allowed to proceed it can become irreparable because of joint changes. The efforts of the muscles to overcome the tension lines will put such severe stress on the bands of scar that ulceration and hyperkeratosis with secondary additional scarring is almost certain. There is also the ever present danger of infection through this wound with the prospect of cellulitis and the further progress of fibrosis. The repair of these injuries should therefore be carried out as early as possible and when a flexure is involved the repair should be carried so far laterally that any

shrinkage of the scar joining the graft to the intact skin will not contract and perpetuate the defect for which the operation was performed. In other words no vertical part of the scar between the graft and the intact skin must lie on the flexor aspect of the limb.

Legs

Injuries in this region are complicated by two factors. The first is the subcutaneous border of the tibia, which even in adults is subject to frequent minor traumata, and the second is the fact that the normal blood supply to the skin in the lower half of the leg is anatomically extremely poor. Free grafts suffer from two disadvantages. Firstly they will not withstand injury unless they have a satisfactory subcutaneous cushion to insulate them and secondly they derive their entire blood supply from the base on which they are implanted. So far as the leg is concerned then, the use of skin grafts except as a primary dressing is usually confined to the posterior aspects of the calf. This is an area which is not commonly injured and in order to cope with ordinary lesions it is often necessary to utilise a method of repair which does not suffer from the defects inherent in a free skin graft.

Insulation can be effected over the tibial crest only by importing subcutaneous fat. A blood supply which is partly peripheral as well as arising from the base, can be obtained by using a flap, so a flap it must be, but not except in very unusual circumstances one derived locally. The difficulty of transposing tissue from the calf to the anterior aspect of the leg is largely dependent upon the cylindrical form of the limb. No experienced surgeon approaches the problem with enthusiasm but it seems such a rational thing to do that many fail to appreciate its inherent difficulties. It must be remembered that failure not only leaves the original defect uncovered but also creates a new and probably more extensive one adjacent to it. There is only one area which can easily be brought into approximation with the leg and kept there for the three weeks or so which will be required to establish a good blood supply. That is the opposite calf. The defect over the tibia therefore is in actual fact transposed from the front of one leg, where a split skin graft is useless, to the back of the other leg, where such a graft lying on a muscular bed will succeed.

The foot is very similarly treated.

The arm and the hand have been left until last because of their paramount importance. Many of the characteristics which differentiate men from animals depend upon the specialised function which the upper limb has acquired. At the same time it is this limb with which most of us earn our living and its integrity is of primary economic importance.

The arm

Injuries to the arm are not as a rule prone to cause skin loss. The exception is perhaps burns, both by heat, chemicals and electricity. The

forearm is most likely to be involved and because it houses the motive power for the fingers repair is of extreme urgency and importance.

Frequently a thiersch graft will suffice but in this area we have the very great advantage that if subcutaneous tissue as well as skin is

Fig. 4.

(A) (B)

Arm lacerated in machinery with circumferential loss of skin, extensive laceration of muscle and division of both median and ulnar nerves. Free skin graft applied as primary repair and the condition shown at (B) is the same arm two months after operation.

desirable, and in electrical burns it always is, the entire expanse of the chest and belly walls is immediately available.

Finally we come to the **hand**, perhaps the most important of man's individual members. Its development and function have reached such a high pitch that even a minor lesion which would have been inappreciable elsewhere can spell disaster. The greatest risks are the severance of nerve or tendon and those of infection. The former are seldom associated with skin losses and their consideration does not now concern us. When skin loss does occur infection is an almost inevitable sequel. After that comes disorganization with tendons frozen, joints immobile and sensation no longer effective. The precise instrument is replaced by a cold, inert and useless structure, painful and sensitive to changes in temperature

which are reflected by vascular phenomena of marked intensity, while the whole represents nothing but a shadow of its former miraculous efficiency.

The type of injury which can cause such a disaster is manifold. First come burns. These are usually confined to the dorsum of the hand and are not immediately extremely dangerous. If they are allowed to heal spontaneously they will often lead to such gross shortage of skin, both longitudinally and transversely, that neither the metacarpo-phalangeal nor the inter-phalangeal joints can function ; flexion is limited, hyperextension is the rule ; joints are disorganized and apposition and opposition are lost. All these can be forestalled by the early application of free grafts.

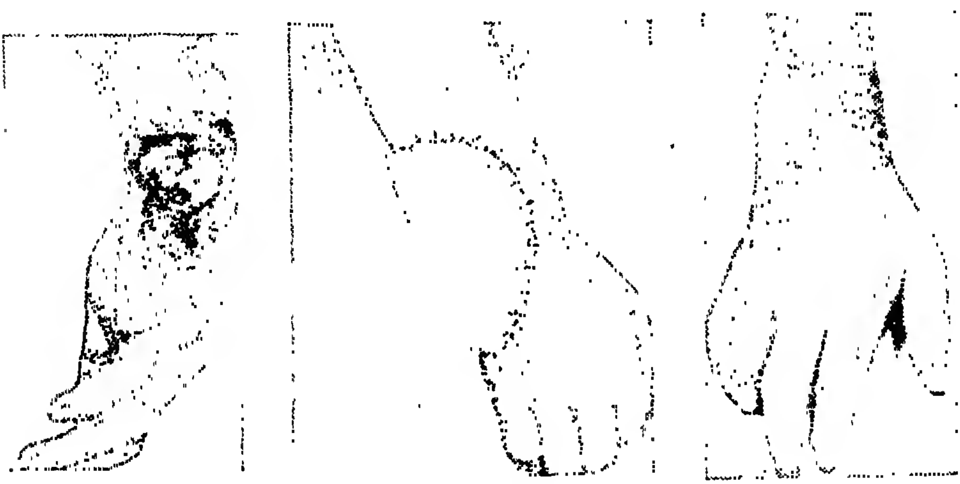

Fig. 5.

(A) (B) (C)

(A) Electrical burn exposing the right wrist joint, treated by immediate excision and the application of a flap from the abdomen (B). (C) shows condition after detachment of the flap from the abdomen.

The contra indication for a free graft is an extensive exposure of such avascular structures as tendon, bone or joint capsule. The type of cover for this lesion must be one which derives its blood supply from the periphery of the defect and not from the base of the defect. A flap from the abdomen is readily available.

Even more common are injuries which concern the pulp and the tips of the fingers. The threat in this case is not to mobility but to sensation. The method of repair must be early enough to obviate the formation of painful scars and intelligent enough to replace the destroyed tissues with others as like them as possible. When the severed tissue is available it can be used as a free graft, except when bone is exposed. Under those circumstances a flap of skin will give the optimal result. The new skin should contain tactile sense organs of a type closely allied to those

normally found in the lost area. Reinnervation will then be more perfect than can be the case if the regenerating nerve fails to find the correct type of end organ with which to link up. The skin must therefore come from the hand itself and the proximal third of the palm can often be used as a donor area. A small flap of skin with some subcutaneous tissue is dissected up but retains its blood supply from its original site. It is attached to the finger tip and the raw surface in the donor area of the palm is covered by a small Wolfe graft. The position is maintained by light paster for about three weeks but it should not be necessary for the patient to remain away from work during this time. At the end of three weeks the small pedicle can be divided and the new flap inset. Such a restoration will result in a functional finger with good sensation and should be obtained at the expense of the minimal disturbance of the patient's economic welfare.

FOODS AND FEEDING AS THEY AFFECT TEETH AND THEIR ENVIRONMENT

Charles Tomes Lecture delivered at The Royal College of Surgeons of England
on
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by

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IT WILL BE obvious that ideal development and growth of the jaws and teeth will be coincident with ideal development of the body as a whole, and that that in turn must be largely governed by the manner and materials of which that body is built; and this in turn will depend on diet; but we also generally believe that errors in diet or the manner of taking it are largely responsible for the dental and parodontal lesions to which human flesh is heir.

Diet therefore intimately concerns the dental surgeon's outlook, and so the search for perfection in diet goes on; one is reminded here of a saying attributed to Sir Frederick Gowland Hopkins, that no man or animal ever yet had a perfect diet because we do not know what a perfect diet consists of.

Dental Surgeons look on foods from a different point of view from that of the physician or physiologist; calories concern us not at all, the changes taking place during digestion and before absorption hardly at all—and only then in so far as concerns chemical changes taking place in the mouth. We fully recognize the importance of the accessory food factors but do not regard them as *commonly* influencing the incidence of dental caries or parodontal disease, though we know that their deficiency can influence dental structure and certain gingival conditions profoundly, and their absence cause death.

What concerns us chiefly are the *physical characters* and *chemistry* of foods and the *manner of taking them.*

So far as our knowledge goes one or other of these factors may directly or indirectly affect both the teeth and their surroundings. The teeth, with reference to their crowding or irregularity, their shape and structure, and the incidence of dental caries; their surroundings with reference to gingivitis and its common sequel—parodontal disease, and the stability and width of the bony dental arches. And as these effects are mostly slow and progressive they are mainly, but by no means entirely, seen as they affect the permanent dentition.

The teeth being part of the body and not separate entities, and certain materials being required both before and after birth to build that body in perfection, it will be obvious that if these materials are inadequate,

or not available in an assimilable form at the time they are needed, either the body, including the teeth, will be faultily made or the child may die. Before the child is born it is a parasite on its autosite mother, and if these building materials are not then fully available, the mother's body will suffer first, as the parasite grows at her expense, but this does not apply to the mother's teeth which are already completed, though it may affect the cells and metabolism of her body so that they, in turn, affect her oral structures, secretions and teeth.

If however deficiencies are severe they may also affect the child; we know they can interfere with the formation of dental tissues, they may possibly hinder the development of dental formative cells, so that even if dietary perfection is attained later, they may not then be able to function in perfection. The occurrence of hypoplasia of the deciduous teeth is evidence, either that the building materials were not available, or that something interfered with the proper functioning of the formative cells, though conceivably that something was not necessarily a dietary deficiency. Preston Maxwell[1] in a paper on adult and foetal rickets in Chinese women has shown that inadequate diet during pregnancy may result in foetal rickets, and that the deciduous teeth when they erupt may be defective, and it is only logical to infer that other chemical or vitamin deficiencies in the maternal diet may have a like result.

Though the foregoing is logically true there is little other reason to suppose that maternal food deficiencies affect the structure of teeth very much, particularly the permanent teeth; indeed we have no evidence that the formative cells of the permanent teeth are affected by maternal influences save in the transmissions of infections and hereditary variations, and investigation in the United States [2] has shown that 85 per cent. of the total calcification even of the deciduous teeth takes place after birth.

As practical politics I do not think that these possible effects on the deciduous teeth need be regarded too seriously; at the worst they may affect their pleasing appearance on account of structural defects, and these may render them more vulnerable to the causes of dental caries, though this latter will largely, if not entirely, be governed by the physical and chemical characters of the child's post-natal foods.

After birth, when the child has become a separate entity, its physiological method of procuring nourishment is by means of breast feeding, and the perfection of this will depend on the maternal diet; indeed rickets on occasion has occurred in an entirely breast fed child when the maternal diet itself has been deficient. [1] [3]

This manner of feeding has, in the opinion of most, a profound effect on the well being and growth of a child's jaws and teeth, the breast acting as an orthodontic appliance and bringing about the necessary growth and expansion of the jaws and so making room for the teeth, besides giving the child a physiologically efficient diet. Indeed to my mind the results of hand feeding ultimately provide a considerable proportion of work for the orthodontist.

It has been a point of great interest to me as to how long the physiological period of breast feeding should be, and in an extensive enquiry made some years ago[4] one found that throughout the mammalian world the period was approximately one-fourth of the period taken to reach adult life, and that in primitive man the period was never less than two and a half years, and some races, such as the Maoris, Esquimaux, North American Indians, Japanese and others it was prolonged to six or more years, and it is coincident that it is in these races the finest and widest bony dental arches were found, and the incidence of caries least of all in human races.

Fig. 1.—Esquimaux children and mother showing wide jaws.

Fig. 2.—Maori Chief Porotiti showing wide jaws.

Reproduced from "The Living Races of Mankind" by kind permission of Hutchinson & Co. (Publishers), Ltd.

Conversely the change to the infant and other foods of civilisation has changed the incidence of caries and character of the arches in these races considerably and suddenly; in the Maoris, for instance, the incidence of caries changed from 1 per cent. to about 90 per cent., and much the same has happened to the Esquimaux where they have come into close contact with American civilisation around Baffins Bay, and have now as a result much dental caries and deformed dental arches, instead of the 1 per cent. caries of their primitive state.

Before the introduction of infant foods the breast feeding of children for 2 or 3 years was a necessity—there was nothing else to feed them on. In uncivilized Greenland if a child's mother died and a nurse was not available it was destroyed, either by exposure or being cast into the sea; one may think that such things might occur in Greenland which to us

appears an inhospitable terrain, but this also happened in the Belgian Congo and for the same reason, until the advent of the medical missionary.[5]

There is evidence that breast feeding up to 3 years continued in civilized countries till comparatively recently. Shakespeare (A.D. 1564-1616) in Romeo and Juliet, puts the following words into the mouth of Juliet's nurse (Act. 1 Scene 3):

> " On Lanmas-eve at night shall she be fourteen ;
> That shall she, marry ; I remember it well,
> 'Tis since the earthquake now eleven years ;
> and she was weaned,—I never shall forget it,—
> For I had then laid wormwood to my dug."

In the act of suckling, a child does not merely take the mother's nipple into its mouth, but a mouthful of breast; so that the nipple is well to the back of the mouth; doubtless the efforts put forward by the jaws, tongue and cheeks in the child's efforts to obtain nourishment account for this perfection in width of the arches and for that physiological spacing of the deciduous teeth, which should be seen at 5 years, but which is not too often seen in children in this country to-day, though clinically one does sometimes find them spaced at this age after 10 or 12 months breast feeding.

When I first drew attention to this prolonged suckling by many races, some thought it was not feasible, as rapid subsequent births would necessitate several children being suckled simultaneously, but the fact had not been taken into account that prolonged suckling is Nature's method of birth control, by inhibiting ovulation, and is successful in some 70 per cent. cases; and this explains why primitive races do not have such large families as used to occur in civilized races. In this connection I always think of a confinement I attended in student days; three friends of the prospective mother were present on my arrival and proudly informed me that collectively they had given birth to forty-nine children (18, 16 and 15); only about a quarter of them were living however. Such families do not occur among primitive races for the reason given, until they start using the proprietary infant foods of civilisation.

One has only to look at specimens of bottle fed jaws (Fig. 3) in the Museum downstairs to appreciate the bony deformities and narrowness of the jaws, and subsequent irregularity and crowding of teeth which may be produced in this manner, and to appreciate how a child may be permanently handicapped and predisposed to caries and parodontal disease—besides suffering from the inadequacies, food deficiencies and physical deficiencies resulting from some artificial diets; and possibly also defects in physical appearance.

The breast fed child, then, erupting well formed deciduous teeth into ideally shaped bony arches will, as it acquires independence, select for choice such foods as necessitate mastication, and so further assist in the growth and development of its jaws.

Indeed all foods, particularly for children once they have acquired teeth, should be either such as they drink or such as compel mastication—just as the comparatively caries-free wild animals have—semi-solid foods

Fig. 3—Maxilla of tube-bottle fed child.

such as milk puddings, etc., are often anathema to the full-toothed child who prefers something it can dig its teeth into.

So far then, partly by the chemical and physical characters of the foods it may have been given, but chiefly by the manner of taking them, the child, at this young stage may already be handicapped to the extent of:

Lack of growth of the jaws ; leading to—
Crowding of the deciduous teeth ;
Increased liability to—or possibly extensive—caries ;
Liability to, or actual, gingivitis on account of refined food stasis ;
Possibly unpleasing dental appearance on account of hypoplasia ;

and all these disabilities may have occurred by the age of three years or less.

Let us now consider foods with reference to the *permanent* teeth.

As I have already said there is no evidence that ante-natal maternal influences affect the permanent teeth, except in the transmission of infections and hereditary variations ; but post-natal dietetic errors, deficiencies and illnesses, by interfering with trophic function during their formative period may profoundly affect their structure ; and of these post-natal factors rickets and acute infective illnesses are the chief, the former, of course, originating mainly from dietetic deficiencies.

These appear to give rise to the faulty laying down of enamel matrix rather than errors in calcification. As already stated Hess and others[2] have shown that 85 per cent. of the calcification of the deciduous teeth takes place after birth, yet we know that the faultiness of the enamel can be initiated and fixed in utero ; and we know that this faulty enamel in the permanent teeth, nowadays usually appears very evenly and densely

calcified early in life, though it did not do so thirty or more years ago when the child's dietetic standards were lower.

Rickets, a disease of malnutrition due to the absence or non-absorption of various or several factors is most active during the period of early formation of the permanent teeth, and affects those teeth forming during the period of deficiency. These effects, notably on incisors and permanent first molars used to be very commonly seen, affecting from 4 to 16 per cent. of the different social grades. Now, however, owing largely to the ration of milk to children and the teaching of maternity and child welfare clinics, the incidence of these dental defects is getting quite rare.

Similarly, now that children are so freely immunised against some of the acute infective fevers, the linear form of hypoplasia, which they produced when occurring during an active phase of enamel matrix formation, is considerably reduced in its incidence, and getting rare.

Should the hypoplasia of rickets have occurred, particularly if the deficiencies were of some years duration, the child now, at the age of 9 or 10 years, may have :

Crowded, irregular and maloccluding teeth on account of lack of bony growth, and
Unsightly and pitted permanent incisor teeth,

each of these giving an unpleasing appearance ; and an increased liability to caries and parodontal disease should it be exposed to their causative factors—on account of the many potential stagnation areas present.

But this increased liability to caries does not nowadays mean that caries will occur. At the Girls' Village Home, Barkingside, just before the war (1939) commenced, I had under observation 17 girls in their teenage (or 1·2 per cent. of the whole population there) with marked rickety hypoplasia, but only two of them had any dental caries, the causative factor of the hypoplasia, though of long standing, was only active before their entry to the Homes, and their efficient diet there which included plenty of milk, had prevented, or given them some immunity to, caries.

The congenitally syphilitic child is often an unwanted child, and so peculiarly liable to suffer from malnutrition ; Fig. 4 shows the stigmata of both congenital syphilis and a trophic hypoplasia.

As malnutrition definitely predisposes to infection one may say that it predisposes the child to naso-pharyngeal infection and obstruction in the form of adenoids and thereby commonly gives rise to mouth breathing.

This, in turn, gives rise to that extremely common form of anterior gingivitis so frequently seen in children even at the present day. Indeed an anterior gingivitis in children—and often in adults—is pathognomonic of mouth breathing.

It is a serious complaint, because it is almost always a precursor of parodontal disease with its oral sepsis and early loss of teeth, and its

course is assisted by food stasis around the necks of the affected teeth while the condition lasts, which may be for many years or throughout

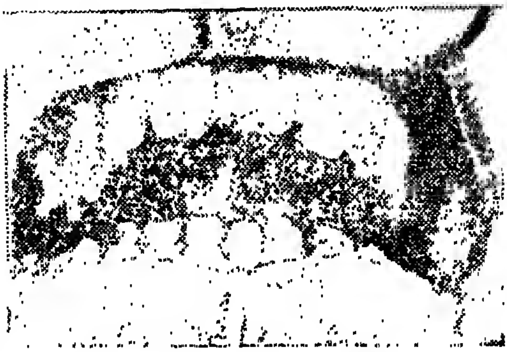

Fig. 4—Syphilitic and trophic hypoplasias coincident.

life as the dental and gingival conditions are progressive (Fig. 5) and their progress is still further assisted by the fact that the anterior teeth in civilised races are ornamental rather than functional, as civilised man uses a knife and fork instead of his incisor teeth.

Many still appear to think that if the nasal obstruction is removed that is all that need be done, but experience does not bear this out. During the day nasal breathing may be re-established if the child is admonished when seen with its mouth open, but it invariably reverts to mouth breathing at night, and unless treated this habit will persist throughout life.

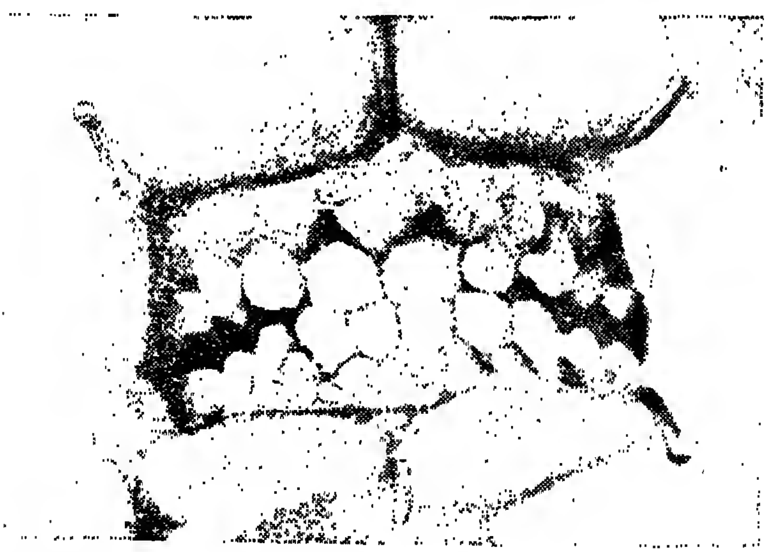

Fig. 5.—Anterior gingivitis in mouth-breathing girl of 14 ; adenoids removed at five years ; no other treatment.

Frequently one has been approached by students seeking cure for a slight anterior gingivitis which has proved persistent and intractable to local treatment—they are obviously not diurnal mouth breathers, but inquiry invariably elicits that the adenoid operation was done in childhood, they are not usually conscious that they revert to the mouth breathing habit at night, but further inquiry invariably elicits this fact also.

Apart from local treatment of the anterior gingivitis, what can be done about it? Over many years I have tried both lip and breathing exercises, and though both are helpful they do not prevent nocturnal mouth breathing.

The wearing of an oral screen at night is the only cure that I know of, but it is a cure, used for choice in conjunction with the other measures. To my mind every child who has the adenoid operation done needs this treatment, as otherwise the habit persists.

I believe it is true that this habit, by allowing cold and infected or dust laden air to enter the respiratory tubes direct, instead of being warmed and filtered by the nasal mucosa, creates a strong predisposition to chronic bronchitis later on—indeed it is well known that many bronchitics sleep with their mouths open. One cannot at the moment regard it as proven, but the argument, in view of such clinical facts as are available, seems logical and is probably true.

Up till about 30 years ago, when the coincidence of rickets and adenoids was very common, the softened bony jaws plus the tension of the cheeks when the mouth was open gave rise to (Fig. 6) that common and horrible

Fig. 6.—Saddle-shaped arch caused by rickets plus adenoids.

deformity of the jaws and teeth known as the " Saddle arch,"—fortunately we hardly ever see it now—and for illustration of this deformity one now has to go to the plaster records of it in the Ondontological Museum here.

The other way in which parodontal disease is initiated also concerns foods, but does not commonly make itself obvious till perhaps mid-life.

It is the end result of the fermentation of any or all forms of food detritus stagnating at the gingival margins, and is often first noted in the region of the cheek teeth ; obviously the more refined foods are liable to collect and stagnate in this manner.

I have often likened the building of the body—or a tooth—to the building of a house ; skilled workmen (efficiently formed and functioning cells) using the best materials (foods), will produce the perfect house (tooth) on an ideal foundation (parodontal tissues) ; and poor workmen using such indifferent and substitute materials as they can obtain will produce a jerry-built house with faulty foundations. Yet when first finished both may look identical ; if you can imagine the houses as being reduced to the size of teeth, histological and chemical examination might show but little difference, but there can be no question which will better withstand the stresses and actions of time and adverse elements, though both are acted on by them.

In this connection I am reminded of when I first attended the boys at Dr. Barnardo's Homes 40 years ago ; at that time the dietary omissions and deficiencies of many of them before admission had been appalling ; they had not had the wherewithal or power to build either efficient bodies or teeth, and there were several boys there, aged about 14 or 15, who had parodontal disease so badly that their permanent first molars were only attached by their extreme apices, and I removed them with my fingers ; occasionally, too, some of their anterior teeth had dropped out. Now that the days of milk rations, maternity and child welfare clinics, school inspections, and education in dietetic values have come, we shall probably never see such cases again.

And now we come to the influences of foods on dental caries. A few words first as to its incidence.

I have already shown how the incidences in primitive Maoris and Esquimaux changed suddenly from almost zero to those approximating the incidences of the civilised races with whom each came into intimate contact, and curiously, the present day incidence in New Zealand is one of the highest in the whole of the civilised world.

We know that the incidence in this country is high, but as a matter of fact, among the bulk of the young population it is now lower than it has been, certainly for the past 50 years. It is interesting here to note its incidence in such a cross-section of the population as I have seen over the years at Dr. Barnardo's Homes, where the incidence of caries has always been relatively low.

In 1910, 69 per cent. of all girls aged from 10 to 14 years showed caries in their permanent teeth (only).

In 1919, the figure had fallen to 52 per cent.[6,7] And now, in 1947, it is 34 per cent.

At another school with which I was connected for over 30 years, and where the incidence was always much higher :—

In 1910, 93 per cent. of the girls aged 10 to 14 years had carious permanent teeth, whereas now, in 1947, only just over 28 per cent. have them.

As normality rules that only the enamel-covered portion of a tooth comes into contact with foods, one has only to consider how enamel may so be acted on, and it is generally agreed that its destruction must primarily be occasioned by some means of decalcification.

How then can foods affect the incidence of caries in teeth, apart from the method of taking them, and a possibly narrowed arch?

Apart from the accessory food factors our foods consist of proteins, carbohydrates, fats, water and salts.

If *Proteins* stagnate in the mouth but little decalcifying reaction can be produced, while alkaline products are produced in excess, so that the general reaction is alkaline and cannot affect enamel; *Fats* are practically unchanged in the mouth and so cannot directly affect it; *Water* is neutral and therefore inert; and *Salts*, expressed mainly from vegetable foods are mainly neutral, but in any case the vegetable matter from which they are expressed acts as a tooth brush so that they can not remain static.

Moreover, except for cooking we usually take these foods as the relatively caries-free wild animals take them.

But *Carbohydrates* are another question entirely. They are the one food that civilised man takes in an ultra-refined form, and often to excess. Both chemically and physically he takes them in forms not available to wild animals, and in such forms that they may stagnate, adhere to, or remain in prolonged contact with the enamel. In these forms they constitute the one food which may on fermentation produce an acid reaction—and in contact with the enamel.

We take them as starches, and as di-saccharide and mono-saccharide sugars.

The uncooked starch granule can do but little harm—its cellulose covering protects it from bacterial or enzyme action, but cooking ruptures the covering so that it may be acted on by the salivary enzyme ptyalin to convert it into the di-saccharide sugar maltose, and then by a hydrolytic bacterial ferment into the mono-saccharide dextrose, and bacterial action on mono-saccharides produces lactic acid. Moreover starch in this state is very adherent.

I can think of very few instances in which civilised man eats his starches uncooked—he nearly always reduces them to a potentially harmful substance first—indeed in eating biscuits (bis cocta=twice cooked) he takes every care that it shall be in such harmful state before he eats it. Similarly with porridges and milk puddings: they are not masticated, but shovelled into the mouth with an eye on the clock lest the train to school or business should be missed, and they leave a very adhesive residue.

The di-saccharide cane and beet sugars probably do not do so much harm unless retained in the mouth for long periods as in confirmed sweet

eaters, as they are unfermentable until converted by the bacterial ferment invertin to mono-saccharide.

The fermentable mono-saccharides glucose and dextrose which have come into much more frequent use this past 20 years, probably do most harm in least time, they have unfortunately been frequently prescribed for children, and often in orange juice, and the combination of acid and sugar seems to be particularly harmful; one has known of several cases[8] where such a prescription has been followed by 14 or 15 carious teeth during the ensuing twelve months in previously caries free mouths. An exactly comparable state of affairs occurs in the United States of America in connection with a common "cola" beverage, which contains the di-saccharide sucrose and phosphoric acid, and has a pH of 2·6. It causes rapid and severe destruction of the enamel.*

I regard dextrose as a source of great potential dental harm, and concerning this I am informed by dietetic physicians that cane sugar is every whit as good and just as efficacious a prescription for children whose general well-being may profit by taking dextrose.

Apart from this, there is some evidence that orange juice by itself favours the incidence of caries.[8]

Perhaps as strong evidence as any that the carbohydrates are the harmful agent in producing caries may be found in a comparison of the Pitcairn Islanders with those of Tristan da Cunha. Tristan has almost dental perfection and practically no caries; while Pitcairn has rampant caries. Rosalind Young,[9] a native of Pitcairn, refers to the "loss of the front teeth which is quite general." An Admiralty report[10] 1907 states: "The incisors are mostly attacked, those of the upper jaw more than those of the lower . . . giving to many of even the young women a 'toothless hag' appearance;" and another report made on my behalf by the courtesy of the Admiralty in 1911[11] states that in both young men and women the molars also are attacked. These two communities exhibit many points of similarity. Both are descendants mainly of British males and native females; both depend on visiting ships for flour, as cereals are not cultivated by either; fish and eggs form a large proportion of their diet, flesh foods being eaten comparatively sparingly, and deaths in both cases are reported as usually occurring from accident or old age.

But while Tristan depends largely on potatoes and grows apples, Pitcairn produces the very similar yam and sweet potato and also produces sugar cane, "syrup made from its juice being used instead of sugar."

There is a sharp difference in the consumption of milk.

According to Mrs. Rose Rogers[12] who lived at Tristan for 3 years, when children are being weaned at 15 months the custom is to give them milk warm direct from the cow, and milk remains one of their staple foods throughout their lives.

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* "Effects of a Sweet Acid Beverage on Teeth of Experimental Animals." Journ. Amer. Dent. Assoc. 1945. XXXII, 668.

In Pitcairn, on the contrary, there are no cattle as the island is too small; it has goats, but they are wild and not available for dairy purposes. The 1911 Admiralty report states that tinned milk was one of their luxuries.

It would seem therefore that in Pitcairn the teeth developed and calcified in early childhood are chiefly vulnerable, when the physiological body-building foods are in abeyance and sugar is available.

Two hundred and fifty years ago the annual import of sugar into this country was about 3 lbs. per head, in 1928 it was over 101 lbs., in 1911 over 6 lbs. of glucose additional to this was consumed, and the use of this extra glucose has considerably increased since then.

A hundred years ago sugar cost about 1s. per lb., wages were much lower and the purchasing power of money much higher, sugar caddies in those days had locks on them; our grandparents as children, when they had been very very good were given *a* sweet—quite different to the children's peace-time consumption here when sugar cost about 2½d. per lb.

Go through the out-patient waiting room of any large General Hospital on the pediatrician's morning—what is every child doing? Eating cakes and sweets to keep it quiet, and one still quite often sees caries of the incisal edges of the deciduous teeth when the rubber teat is dipped in sugar before insertion into the child's mouth.

The method of decalcification of the enamel in this way attacks first the interprismatic substance of the enamel; but apart from that sugar has a strong chemical affinity for calcium, and in prolonged immersion and incubation of the crowns of teeth in glucose solution, such as might occur in a confirmed sweet-eater, I have found[8] that calcium is abstracted from the enamel, but unlike the acid solution of the interprismatic substance, the calcium here seems to be abstracted from the prisms, so that one can then stain them, but not the interprismatic substance.

The refinement to which our peace-time white flour is subjected is perhaps not quite realised, the fine sifting through silken sieves, usually of 9xx gauge bolting cloth is overdone, it has 97 strands to the inch, though sometimes sieves having 140 strands to the inch are used (14xx).

There was, and probably still is, a wide margin for error in the effects of milk on the nutrition of children, particularly with regard to their teeth; *freshly* pasteurized milk, as used in exactly controlled laboratory work, is now stated by some to have an almost equal value to unpasteurized milk, but commercially pasteurized milk varies considerably, and may give very varying results, especially when kept; such, for instance, as when one sees a specimen of pasteurized milk recorded[13] as containing 178 million organisms per cubic centimetre, of which 29 million were still living, one can well see that the food sold as milk is not always what it should be.

Additional to the foregoing it is a very definite fact that the metabolic capacity of different infants with regard to their foods varies considerably; within the past few years a number of cases have been recorded of twins[14] who from birth had been fed on identical foods, and in each case at about 5 years of age, one child of each pair was a normal healthy child and the other suffered from pronounced rickets. Similar results have also been found by breeders of animals and birds, and yet rickets is often believed to be due wholly to dietary deficiency.

To my mind there is no doubt, as I taught for many years and ultimately published, [15,16] that if small babies must be hand fed, one cannot improve on the foods which Nature provides for helpless and developing vertebrates, namely, fresh milk and egg yolk, suitably prepared; indeed I once saw 37 consecutive children of an average age of 4 years, who were subnormal on admission and had been brought up in this way from birth, and had no dental caries at all in spite of daily sweets.[17]

There can be no doubt that the present day remarkable decrease of caries in children, as indicated by the figures I quoted earlier (and the decrease is perhaps even more marked in the deciduous teeth), is due to the milk ration which they now get, coupled with the severe war time restrictions of sugar, cakes and biscuits; and that the milk ration is also accountable for the disappearance or comparative absence of structural defects other than those ordinarily described as hypoplasia.

The permanent teeth of the efficiently brought up child appear to me to be of a more bunodont character than usually seen, with cusps more rounded, and fissures and pits at a minimum, or indeed hardly existent.

Once, however, the carious process was initiated, its progress was far more rapid in the young, probably on account of the incompletely calcified interprismatic substance of the enamel at the time the teeth erupt, now, however, it is not so rapid as it used to be.

Other things besides foods influence the occurrence or liability to caries, salivary secretion for example, about the varying composition and reactions of which we still have a great deal to learn; though we have plenty of evidence that it influences dental and gingival conditions considerably, but they can not be included as within my present scope.

The subject matter of this paper is large, many aspects of it have not been touched on, the particular beneficence of certain foods at certain times and in certain forms has not been mentioned; I have merely endeavoured to indicate the commoner errors which initiate the commoner dental and gingival diseases that affect the individual so frequently.

Much of its teaching may be regarded as elementary, but it is supported by experience provided by the passage of time; and from the changes now taking place in this country in professional experience, teaching and practice, it is to be hoped that still further improvement in dental conditions may ensue.

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[3] *Lancet*, 1933. CCXXV, ii, 757

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[8] *Brit. Dent. Journ.*, 1938. LXIV. 245

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[10] *Admiralty Report*, by Staff Surgeon LOBB., 1907

[11] *Admiralty Report*, by Staff Surgeon LINDOP, 1911

[12] Personal communication from Mrs. ROSE ROGERS

[13] *Brit. Med. Journ.*, 1933, i, 337

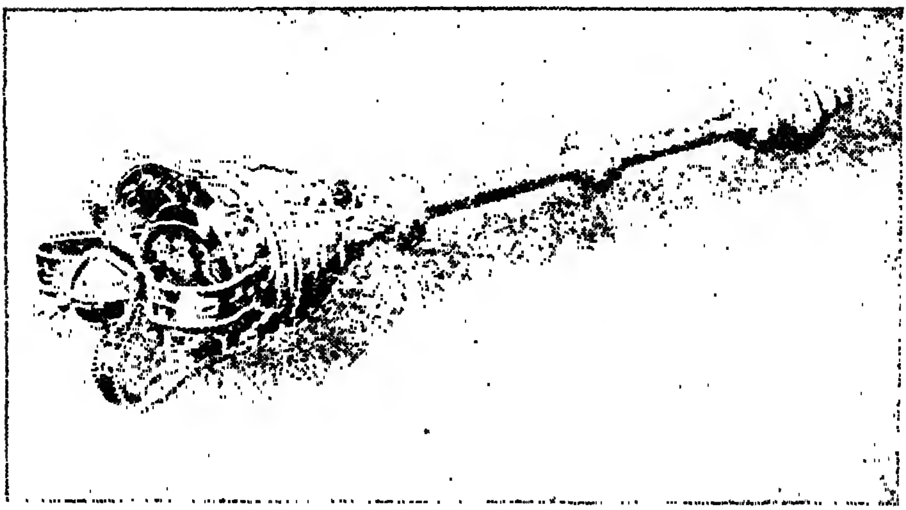
[14] *Brit. Med. Journ.*, 1932, i, 769, 862 and 912

[15] *Public Health*, 1934. XLVII, 388. Read 1.12.33

[16] *Brit. Dent. Journ.*, 1934. LVI, 125. Read 16.12.33

[17] *Proc. Roy. Soc. Med.*, 1932. XXV (Section of Odontology) 11. See Table III

THE CEREMONIAL MACE OF THE ROYAL COLLEGE OF SURGEONS



UNDER THE Royal Charter of February 13, 1822, granted by George IV in the third year of his reign, the title of Master was changed to President, the Governors were styled Vice-Presidents and the Court of Assistants became the Council of the College. Under the same Charter the College was given authority to have a Mace. The terms of the relevant clause were as follows:

> "And it is our further Will and Pleasure that it shall and may be lawful to and for the said College at all times hereafter, and upon all such occasions as they shall think proper and expedient to exercise and enjoy the right and privilege of having a Mace, and of causing the same to be borne by such Officer as they shall appoint for that purpose."

A special meeting of the Council was convened on February 13, 1822, for the reading of the Charter, the first President being Sir Everard Home, and the Vice-Presidents being Sir William Blizard and Mr. Henry Cline. The Minutes record that the Charter having been read, "A Mace which had been obtained by the President from the Lord Chamberlain for the occasion was laid upon the table of the Council." It was resolved "that in pursuance of the authority of the Charter a Mace be provided under the direction of the President and Vice-Presidents."

The Minutes of the Council Meeting of April 12, 1822, record that "The President reported with much gratification that His Majesty has been graciously pleased to declare his royal Intention of Presenting

a Mace to the College, the Expense of which will be defrayed out of the Privy Purse." At the meeting of the Council on July 12, the President opened the proceedings by "presenting to the College, from the Crown, the Mace which had been issued from the Lord Chamberlain's office by the command of His Majesty, and, such Mace being laid upon the table, the President stated that His Majesty had been pleased to express his entire approbation of the manner in which such Mace had been executed and that the Inscription was dictated by His Majesty."

The Mace is inscribed that it was wrought by "Nundell Bridge et Nundell, Aurifices Regis, London."

It is of silver throughout, richly gilded, and measures four feet four inches in length, and weighs 14 pounds 9 ounces.

The head is surmounted by the Royal Crown, and under the Canopy are the Arms of Great Britain. Below are the Royal cypher and the national emblems, Rose, Shamrock and Thistle, together with a Leaping Horse, the badge of the House of Hanover. The brackets supporting the head are formed of caryatides. The staff is decorated with a pattern of roses, shamrocks, and thistles entwined. It is inscribed:—

EX MUNIFICENTIA
AUGUSTISSIMI MONARCHAE
GEORGII IV
DEI GRA: BRITTANIARUM REGIS &C.,
COLLEGII REGALIS CHIRURGORUM
PATRONI OPTIMI
AN: DOM: MDCCCXXII
EVERARDO HOME BARONETTO PRIMO PRÆSIDE

The Council resolved "that, as an expression of gratitude for the repeated marks of His Majesty's condescension and special Favour, Francis Chantrey, Esq. be authorised to prepare a marble Bust of our excellent Sovereign and royal Patron." The bust was duly executed by Sir Francis Chantrey and ever since has held an honoured place in the Council Room of the College.

DIARY FOR SEPTEMBER (15th-30th)

Mon. 15	3.45	Prof. F. G. Young—Endocrines and Carbohydrate Metabolism (ii).
	5.00	Prof. J. H. Biggart—The Pathology of Virilism.
Tues. 16	3.45	Dr. R. G. Macfarlane—Blood Coagulation.
	5.00	Prof. J. H. Biggart—Some Modern Concepts in the Pathogenesis of Vascular Disease.
	8.00	Dinner to the Delegates and Members of the International Committee of the International Society of Surgery.
Thur. 18	8.00	Reception to Members of the International Society of Surgery.
Mon. 22	4.00	Presentation of Lecturn by American College of Surgeons.
	5.00	Dr. A. W. Allen—Moynihan Lecture—Duodenal Ulcer.
Tues. 23	5.00	Dr. F. H. Lahey—Cecil Joll Lecture—Hyperthyroidism.
Wed. 24	5.00	Prof. W. E. Gallie—Moynihan Lecture—Recurring Dislocation of the Shoulder.
Thur. 25	5.00	Dr. E. A. Graham—Lister Oration—Some Aspects of Bronchiogenic Carcinoma.
Fri. 26	5.00	Prof. A. Blaylock—Moynihan Lecture—Congenital Cardiovascular Defects.
Mon. 29	5.00	Prof. Hassan Ibrahim—Hunterian Lecture—Bilharziasis and Bilharzial Cancer of the Bladder.
Tues. 30	5.00	Prof. H. Wookey—Hunterian Lecture—The Surgical Treatment of Malignant Disease of the Pharynx and Oesophagus.

DIARY FOR OCTOBER

Wed. 1	5.00	Prof. E. Finch—The Cancer Problem.
Thur. 2	5.00	Mr. H. C. Edwards—The Treatment of Hernia.
Fri. 3	5.00	Prof. R. M. Walker—Surgery of the Pancreas.
Mon. 6	5.00	Mr. N. R. Barrett—Neoplasms of the Lung and their Treatment.
	6.15	Dr. J. J. Brennan—Endotracheal Anæsthesia.
Tues. 7	5.00	Mr. A. L. Abel—Surgery of the Oesophagus.
	6.15	Dr. A. D. Marston—Pre-anæsthetic Treatment.
Wed. 8	5.00	Mr. G. F. Rowbotham—Head Injuries.
	6.15	Dr. C. Langton Hewer—Anæsthesia for Thoracic Surgery.
Thur. 9	5.00	Mr. A. M. A. Moore—Surgery of the Tendons.
	6.15	Dr. T. C. Gray—d-Tubocurarine Chloride and its use in Anæsthesia.
Fri. 10	5.00	Prof. J. R. Learmonth—Surgery of Portal Hypertension.
	6.15	Dr. J. Gillies—The Volatile Anæsthetic Agents—Their Present Status.
Mon. 13	5.00	Prof. Ian Aird—Surgery of the Biliary System.
	6.15	Dr. W. W. Mushin—Signs of Anæsthesia.
Tues. 14	5.00	Mr. C. E. Shattock—Appendicitis.
	6.15	Dr. W. W. Mushin—Spinal Analgesia.
Wed. 15	5.00	Mr. G. Massie—Neoplasms of the Colon.
	6.15	Dr. E. A. Pask—Resuscitation.
Thur. 16	3.45	Dr. J. Garlock—Surgical Treatment of Carcinoma of the Oesophagus.
	5.00	Sir Stanford Cade—Cancer of the Mouth.
	6.15	Dr. B. R. M. Johnson—Intravenous Anæsthesia.
Fri. 17	5.00	Prof. Murray A. Falconer—Hunterian Lecture—A Study of Principles and Results of Lumbar Intervertebral Disc Surgery.
	6.15	Dr. M. Dawkins—Epidural Analgesia.
Mon. 20	6.15	Dr. R. W. Cope—Anæsthesia for Babies and Children.
Tues. 21	6.15	Dr. V. F. Hall—Post-anæsthetic Treatment.
Wed. 22	5.00	Mr. H. F. Lunn—Arris and Gale Lecture—Contribution to the Anatomy of Inguinal Hernia.
Thur. 23	5.00	Prof. W. E. Gye—Imperial Cancer Research Fund Lecture.
Fri. 24	5.00	Mr. H. F. Lunn—Arnott Demonstration—The Pelvis and the Erect Posture.
Mon. 27	5.00	Mr. H. F. Lunn—Arnott Demonstration—The Applied Anatomy of Testicular Descent.
Tues. 28	5.00	Mr. H. F. Lunn—Arnott Demonstration—The Cerebral Cortex and the Status of Man.
Wed. 29	5.00	Mr. W. R. Douglas—Moynihan Lecture.
Thur. 30	5.00	Dr. Craigie—Imperial Cancer Research Fund Lecture.

REPORT OF CONTRIBUTIONS
BY
FELLOWS OF THE AMERICAN COLLEGE OF SURGEONS*

THE HEADQUARTERS of the Royal College of Surgeons of England were damaged through enemy action on the night of May 10-11, 1941, when incendiaries fell on the College followed by a high explosive bomb on the Museum and the War Museum. Details concerning the damage were included in an article on the Royal College of Surgeons that was published in the September, 1945, BULLETIN of the American College of Surgeons.

Realising the early, the continuing, and the far-reaching significance of the Royal College to past, present and future surgery of the world, the Board of Regents of the American College felt that the individual Fellows should be offered the privilege of participating in the restoration of the Royal College properties. Accordingly, the Regents extended an invitation to Fellows of the American College to contribute toward the Royal College's rehabilitation fund. Contributions by 1,518 Fellows of the American College represent a total of $31,511.75.

Communication sent to the Royal College of Surgeons of England by the American College of Surgeons:

May 2, 1947.

SIR ALFRED WEBB-JOHNSON,
President, Royal College of Surgeons of England,
Lincoln's Inn Fields,
London, W.C.2, England.

My Dear Sir Alfred,

From its founding in 1913 the American College of Surgeons has been benefited by its cordial relations with the Royal College of Surgeons of England, after which it was in many respects patterned. Sir Rickman Godlee, a nephew of Lord Lister, was President of the English College in 1913, and he personally represented his organization at the inaugural convocation of the American College of Surgeons, presented an official message of greeting, good wishes, and hope, and was received into Honorary Fellowship in the newborn College. Since that eventful occasion, many mutual interests have strengthened the bonds between the two organizations and their individual members.

The American College of Surgeons viewed with sympathy the extensive damage through enemy action to the headquarters of the Royal College of

*This report was published in the BULLETIN of the American College of Surgeons—Vol. 32, No. 2, June, 1947.

Surgeons in London in May of 1941. Appreciating that through this catastrophe the world was temporarily deprived of the benefits of a scientific treasure whose value, especially to the profession of medicine, was beyond calculation, spontaneously the Board of Regents of the American College of Surgeons voted a token appropriation toward the rebuilding and reconstruction of the damaged Royal College properties, and it also offered to its individual Fellows the opportunity of contributing toward a fund to be utilized in the restoration of the properties. There is now in preparation a brochure that will record the names and addresses of the Fellows of the American College of Surgeons who availed themselves of this privilege. The brochure will be sent to you immediately upon its completion.

The amount that was subscribed by the Fellows of our College represents a total of \$30,951·75* and there is enclosed herewith a draft on the Westminster Bank, Limited, in London, in the amount of £7,680 6s. 9d.

In the words of Lord Moynihan at the time he presented the Great Mace to the American College on behalf of the Consulting Surgeons of the British Armies:

". . . We pray that you may regard it as a symbol of our union in the harsh days of trial; as a pledge of our devotion to the same imperishable ideals; as a witness of our unfaltering and unchanging hope that the members of our profession in the two lands shall be joined in brotherhood forever in the service of mankind."

Sincerely yours,
(Signed) IRVIN ABELL, M.D.,
President and Chairman,
Board of Regents,
American College of Surgeons.

Communication received from the Royal College of Surgeons of England:

May 21, 1947.

DR. IRVIN ABELL,
President and Chairman, Board of Regents,
American College of Surgeons,
40 East Erie Street,
Chicago.

My Dear President,

Your letter has given me and my colleagues the greatest possible pleasure and has filled us with additional zest for the heavy task of restoring the Museum

*Contributions by the Edmonton Chapter, Fellows of the American College of Surgeons, were forwarded to the Royal College separately.

which we hold in trust for the surgeons of the world—enshrining as it does the unique collections of John Hunter. Unfortunately in the holocaust of 1941 many valuable specimens were lost, but, with the help of naturalists and surgeons from all countries, we feel confident of filling the gaps in reasonable time.

Our Museum was unique in the world, and it is impossible to speak too highly of the largeness and order of the Hunterian Collection which has always been the proudest possession of the College. The Museum was a discourse on the human body in relation to the animal kingdom. It stimulated surgeons to study the science as well as the art of surgery, for, although Hunter's work in pathology was overshadowed by his work in comparative anatomy and physiology, yet in Paget's view it was greater than that of any man before or since, and its direct influence was far greater than that of his greatest achievements in physiology.

The Hunterian Collection would not in itself have given its creator his unique and enduring prestige. Hunter was a consistent and expert user of the experimental method in the study of living processes, and it is on this fact that his fame essentially and ultimately rests. It was by impressing this method on his pupils and successors that his services to science and to surgery have had their most extended and their richest effects. Hunter followed Harvey's precept to "search and study out the secrets of Nature by way of experiment," and in Sir Michael Foster's words: "Harvey's work was a shining example for all future inquirers. The patient examination of anatomical features, if possible a comparison of those features in the same organ or part in more animals than one; the laying hold of some explanation of the purpose of those features suggested by the features themselves, and the devising of experiments which should test the validity of that explanation—that was Harvey's three-fold method."

It is now realized that for a knowledge of the causes of disease new methods are required. If, however, we are to be worthy of Hunter's example and teaching, we must not only provide for pioneer work. We must also preserve the broad bases on which the whole edifice of biological knowledge is built. We have therefore obtained endowments for Professorships of Human and Comparative Anatomy and of Human and Comparative Pathology, and for these Chairs we have chosen men of wide biological outlook. We feel that, apart from the needs of the moment, there are fundamental advantages in encouraging men to devote themselves to subjects of this wide scope. The results of various researches along special lines must be built up into a composite whole. From the enormous accumulation of details the truth must be demonstrated by those with wide biological knowledge and creative imagination, and with a faculty for seeing the hidden relations between the various phenomena.

The generous help of our colleagues of the American College of Surgeons

has given us new heart, for we feel that they have a sense of sharing in our great inheritance. In addition to being encouraged by the generous support of the Fellows of your College, we are also deeply moved that they should have sprung so readily and so eagerly to our assistance. The magnificent gift of over £10,000 from the surgeons of America really symbolizes the setting of the seal on the pledges and hopes which Lord Moynihan expressed when presenting the Great Mace to your College—pledges of our devotion to the same imperishable ideals and hopes of our unfaltering and unchanging brotherhood in the service of mankind.

With renewed thanks and cordial and affectionate greetings to my friends and colleagues of the American College of Surgeons,

I remain,
Yours very sincerely,
(Signed) ALFRED WEBB-JOHNSON,
President.

PHYSIOLOGICAL RESPONSES TO WOUNDING

Moynihan Lecture delivered at The Royal College of Surgeons of England

on

8th July, 1947

by

Dr. W. K. Livingston,

Professor of Surgery, University of Oregon, U.S.A.

I AM KEENLY aware of the honour that the President and Council have conferred upon me by their invitation to deliver this Moynihan Lecture. Lord Moynihan's many surgical contributions, and in particular his volumes on "Abdominal Operations" have been an inspiration to surgeons all over the world. I am more than a little awed by the special challenge in this lectureship because no other surgeon has ever captured the particular flavour that Lord Moynihan imparted to his writings. Some surgeons have been able to approach his lucid style and his thoughtful approach to surgical problems, but none of them has been able to reproduce the unobtrusive yet powerful manner in which he was able to project his own great personality into everything that he wrote. In choosing a subject for presentation to-day, it has seemed appropriate to select a subject dealing with military medicine. I have elected to present some of the reactions which wounded men undergo at the moment of wounding, and to attempt to account for these reactions on a physiological basis.

During World War II it was my privilege to serve in the United States Navy and to be assigned to the Oakland Naval Hospital in California. Our military services were much slower than yours to make adequate provision for the care of special types of casualty case, but eventually it was possible for us to establish a peripheral nerve clinic at the Oakland Naval Hospital. We were able to collect 1,278 case histories from men suffering from major nerve disabilities, and in 919 of these cases the wounding agent was a high-velocity missile. The histories we elicited contained the usual data pertinent to the wound and its care, and, in addition, an attempt was made to record what happened to the man at the moment he was hit. Some interesting facts were brought to light by this effort. For instance, less than 15 per cent. of the men claimed to have experienced an immediate onset of pain, and 70 per cent. of them stated flatly that they had "no pain." Approximately one man in four stated that he had no sense of impact, and almost never was there any sensation of penetration of the missile. Even the most grievous wounds from high explosive shell fragments might be indistinguishable from a shower of pebbles or dirt. Twenty-four per cent. of the men had the sensation that the wounded limb was "gone." Even when a marine could see his hand

protuding from his jacket sleeve he might be afraid to stand up for fear the arm would fall out of the sleeve, so completely did the extremity seem to be dissociated from his person. Very commonly the loss of motor and sensory function at the time of wounding was a great deal more extensive than the nerve paralysis which was present when they reached our Hospital. The state of the wounded limb, immediately after wounding was usually that of a flaccid paralysis, but 30 per cent. of the men described some involuntary movement of the affected limb which sometimes suggested that a massive stimulation of nerve fibres had occurred. It is with these involuntary movements and the related phenomena which imply nerve stimulation with which the present discussion is concerned.

Case 1. The pilot of an American fighter plane was attacked by six Japanese " Zero " planes while flying over the ocean at an elevation of some 4,000 feet. A 20mm. shell exploded within the cabin of his plane and several small fragments struck him on the posterior aspect of his right shoulder. His right hand, on the control stick, jerked suddenly across his lap and threw the plane into a tight left spiral dive. His grip closed convulsively on the stick with his thumb pressing the cannon trigger, so that more than half of his ammunition was shot away to no purpose. He was unable to right the plane or stop firing until he had pried the contracted fingers of his right hand from the control stick with his normal left hand. He was dangerously close to the water when he got the plane levelled off. He could see the arm, yet it felt to him that it was " gone " ; that it had been " shot away at the shoulder." He laid the arm across his thigh. For several seconds it "jerked and twitched." These movements were not only involuntary, but the arm seemed as completely dissociated from his person as " a monkey on a stick." When the jerking ceased the muscles seemed to be placid. By the time this man reached his base on Munda within the hour, sensation and motor power were returning gradually. His only residual paralysis involved the radial nerve.

Case 2. A pharmacist's mate was kneeling in front of a medical kit on the sand on Saipan when a mortar shell exploded several yards behind him. He felt a sensation " as if someone had picked me up and shaken me " and fell to the sand. When he attempted to get up he found that his right arm was not functioning. It felt to him that the whole arm had been " shot off." He managed to scramble to his feet and looked for the arm. He looked at the sleeve of his jacket and could not see his hand. Then he noticed that the sleeve was jerking and noted that this was caused by the " jumping and jerking " of the hand with the wrist in sharp flexion. " I thought that it might be partly off, so I pulled it straight to look at it. There was resistance to straightening it, but not hard to do, but when I let it go it jerked right back there in the doubled-up position. It didn't jerk for more than 30 seconds, although I can't be sure of the time." This man's only wound was due to a tiny fragment of steel that struck the outer surface of his upper arm and lodged against the radial

groove. His only residual paralysis involved the radial nerve, at first complete, and eventually making a complete spontaneous recovery of function.

I have said that 30 per cent. of our cases of nerve injury from missile wounds reported involuntary movements. It was not always as easy as it is in the two cases I have cited to state that the movement was due to stimulation of nerve fibres. In many instances, our records did not make it entirely clear that the movement might not have been due to the mechanical force of impact imparted by the missile. After a rigorous elimination of all the cases in which such a doubt could be raised, there remained 16·5 per cent. of our cases in which a movement was described, either tonic or clonic in type, and sustained for a sufficiently long interval to leave no question in our minds that it was due to nerve stimulation. The question naturally arises, was the movement due to direct stimulation of motor fibres, or was it reflex and due to massive stimulation of sensory fibres?

Both types of stimulation doubtless occur when a high-velocity missile passes through living tissue. Animal experiments have shown, that in addition to the impact and the direct destruction caused by the missile itself, there is an enormous release of energy in the wake of the projectile. A large cavity forms within the extremity and this cavity undergoes two or three alternate expansions and contractions. The forces liberated in the wake of a bullet may rupture fascial planes, fracture bones, and stretch vessels and nerves at some distance from the actual path of the missile. Therefore, it is not safe to assume that we are dealing with true reflexes in the two cases I have cited simply because it was the radial nerve (extensor muscles) that was most seriously injured, while the muscular activity obviously involved flexor muscles. On the other hand, the clonic movements described in each case must depend on reflex circuits. There is evidence from these, and many similar cases, that the wounding mechanism can cause massive and sustained stimulation of sensory nerves.

Reflex Paralysis

In 1864 during the Civil War between the States, Mitchell, Morehouse and Keen reported a few cases in which bullet wounds of one part of the body was associated with persisting paralysis in distant parts. They believed that the distant paralysis was of reflex origin and not dependent upon organic lesions in the paralysed part. In studying our own cases we were on the lookout for this kind of " reflex paralysis " but failed to observe it. I would be more accurate to say that we observed no instances of distant paralysis of a persistent nature in which we could be reasonably sure that the causative factor was reflex and not dependent upon organic lesions. However, we did encounter a few cases in which distant effects of a transient nature suggested a reflex effect from the site of wounding.

These cases were of two types :—(*a*) those in which a transient paralysis occurred at much higher levels than the lesion, and (*b*) those with involuntary movements of distant parts. An instance of the first type is furnished by a marine whose left lower extremity was rendered functionless by a machine-gun bullet through his left thigh. He remained standing until he was hit in the right thigh. He fell, and for a period of an hour or more had a complete loss of sensation and motor control " from his waist down." The second type is illustrated by the following case.

Case 3. A marine private was wounded by mortar shell fragments on Iwo Jima. He was just getting up on one knee when the shell exploded about ten yards behind and to his left. He sustained wounds of the left upper arm and the left thigh. The force of the explosion flung his left arm behind his head, from which position it was retrieved by a medical corps man who rendered first aid. For a period of five or ten minutes there were forceful, clonic movements of the arm and leg on the right, the *unwounded* side, which he described as similar to those occurring during an epileptic " fit." When these movements subsided he seemed to have normal control over these extremities, whereas there was neither sensory nor motor function in the left arm and leg for five days. Then motor control gradually appeared, and at the end of five months his only neurological residuals were a paralysis of the left musculo-cutaneous nerve, and the left peroneal.

Hallucinations of Posture

A third group of cases, small in number, but of considerable interest, was made up of men who reported having experienced hallucinations of posture. During the phase when their wounded limb might be devoid of both sensory and motor control, the man would have the impression that the limb was in quite a different position than it actually was. The sensory hallucination might be so strong that neither visual or tactile confirmation of the actual position of the extremity could convince the man of the facts.

Case 4. A marine sergeant was shot through his right brachial plexus on the Island of Tinian. All motor and sensory function in the right arm was abolished for several months. Immediately after he was hit, and for about 45 minutes thereafter he had the impression that the extremity had been " shot off " at the shoulder. Then he began to perceive sensations ascribed to the arm and hand. It seemed to him that his arm was down at his side, and that the hand was alternately opening and closing " as if it were trying to grab something." He looked down along his body as he lay on a stretcher but failed to see his hand. He asked a marine near him, " What in hell is my hand grabbing for ? " He was told that his hand was lying quietly across his body. He kept asking, " Aren't my fingers moving ? " and, in spite of answers to the contrary,

and his own visual and tactile confirmation of the actual position of the hand, he continued to experience, for an hour or more, the feeling that his hand was at his side alternately opening and closing.

Two of our men who reported a transient hallucination of posture immediately after wounding, continued to experience a recurrence of the hallucination over a period of days, when they assumed some particular posture in bed.

Comment

I do not believe that these transient reactions to wounding can be adequately accounted for on a purely psychological basis. None of these phenomena seemed to serve a useful purpose in protecting the individual from danger. The contrary was usually true. A man shot through his arm might find himself unable to move out of a line of fire until he had loosened, with his normal hand, the convulsive grasp of the fingers of his affected hand on the grass. And the fighter pilot I have mentioned was well aware of the fact that the involuntary movement of his affected hand was jeopardizing his life. The stories of these men suggest no unconscious motivation, but rather a reflex activity mediated by the spinal centres and originating in strong stimulation of sensory nerve fibres.

Transient quadriplegia

The final group of cases I wish to consider is represented by a small number of men who experienced a transient quadriplegia immediately after wounding. I am not including in this group the cases that had definite injuries of the central nervous system in which the quadriplegia persisted for considerable periods of time, or who exhibited lasting neurological residuals. I am emphasizing the term " transient " and by that I mean an interval of time measured in seconds or minutes. Four per cent. of our men, wounded by high-velocity missiles, experienced a transient quadriplegia for a very brief interval, after which function returned to all but the most seriously injured extremity. This phenomenon occurred most frequently as a result of brachial plexus wounds. In an analysis of 100 cases of serious brachial plexus wounding there were 14 men who reported having experienced this type of transient quadriplegia. These wounded men were not rendered unconscious. They remained aware of what was going on around them and could hear and understand what was said to them. Most of them could move their eyes, and some of them could speak. A few reported the feeling that they were " only a head," and had neither the ability to move any part of their bodies, nor an accurate sense of posture.

Case 5. A marine sergeant was hit by a bullet above his right clavicle while in the act of firing through the open turret of a buffalo tank on Peleliu. He fell to the floor of the tank but could not feel his body strike

the steel deck. He remained perfectly conscious and had the conviction that there was nothing left of himself below his neck. He could move his eyes and could hear. In fact he seemed to think that his hearing was unusually acute since he could understand what the radio operator was saying to the tank driver in spite of the roar of the engines. For two or three minutes he was unable to speak. He saw the men take down a first-aid kit and apply a dressing to his neck, yet he did not feel its application. He is sure that by the time he could speak he could also move his head, although he still did not feel his wound or know where his extremities were. In about ten or fifteen minutes feeling and movement came back suddenly to all parts of his body except his right arm, leaving no other residual effects of which he was aware. The loss of function in the right arm remained complete for many weeks. In spite of this complete motor and sensory paralysis in this extremity, he experienced hallucinations of posture for several days. The arm felt to him to be shortened " about six inches " and the hand to be smaller than normal. At intervals he would have the distinct impression that the paralysed limb was sticking out from his body in some abnormal posture which did not correspond to its actual position. These sensory hallucinations faded after a day or two, tending to recur only when he changed his posture in bed. At our first examination two months after wounding, this man had a complete motor and sensory paralysis in his right hand and arm, but no detectable neurological deficits elsewhere.

Among the 33 instances of transient quadriplegia recorded in our series of cases there were a few that reported, that while the state existed, their bodies were drawn into a posture of strong flexion, one man stating that one knee drew up so hard that it struck him sharply on the chin. Three of the men assumed, or retained, a rigid erect position for a few seconds, and then, as the muscles relaxed, pitched over in what seemed to be a flaccid state of the musculature. There were three features which characterized these cases as a group: (1) a sudden, complete loss of voluntary control of all four extremities, coming on immediately after wounding; (2) a retention of consciousness and orientation; and (3) a prompt restoration of function, within a very short time interval, to all but the most seriously injured member.

The phenomena are suggestive of " spinal concussion " as distinguished from a contusion of the spinal cord, or other type of organic injury. They remind one of the phenomena of " cerebral concussion " and there is a strong temptation to seek for an explanation for them among the many experimental studies of cerebral concussion. I am not sure that one is justified in assuming that these two conditions have a common denominator; yet in a spirit of speculation it might be of interest to pursue this line of thought. If there is a factor common to them both, then a further analysis of our cases of transient quadriplegia might be worth making, since these cases have one great advantage over the victims of cerebral concussion, in that they retain consciousness and are able to

describe their subjective experiences. Let us begin such an analysis by listing separately the sensory and motor phenomena reported by our patients.

Perceptual Status

These men are not only conscious and oriented, but to a remarkable degree, retain their ability to perceive stimuli coming from the sensory organs in their heads. At the time they are hit, some of them experience a generalized tingling, compared to an "electric shock." It may be felt all over the body, and in some it may persist throughout the period of quadriplegia. Most of them could see and hear, and what they saw and heard made sense to them. None of them could move any extremity nor tell where it was in space, yet a few of these men were evidently receiving some kind of message from their extremities. This is indicated by the fact that they made a distinction between the most seriously affected member and the other three extremities. They might say, "I was sure my right arm had been shot off, but I didn't think that about my other arm even though I couldn't move it or tell where it was." Their stories indicated that messages were getting through to the sensorium from the intact extremities, even though these messages might not be accurate or complete.

Motor Status

All of these patients lost voluntary control over their extremities, but at the same time many of them could move their eyes and speak. A few reported that they could swallow fluids. Most of them stated that they had a strong desire to move and made conscious efforts to do so. They might explain this desire as due to a realization that they were exposed to further fire and should seek shelter, or the natural wish to find out how seriously they had been wounded. In other words, the individual man had a strong incentive for moving his limbs, and could initiate voluntary impulses. This fact is indicated by purposeful movements of their eyes and their speech. It was evident in many instances that the man tried hard to move his extremities, but the message simply did not get through. This failure of the muscles to respond to volition cannot be attributed to loss of function in the anterior horn cells, because several of the men assumed rigid postures or flexion contractures while the quadriplegic state persisted. One gets the impression that the motor cortex was functioning and the motor horn cells were capable of function, so that whatever it was that prevented voluntary movement must lie in the conducting pathways.

The astonishing feature of transient quadriplegia as reported by our cases was the rapidity with which sensory and motor function was restored. Within a matter of seconds most of the men suddenly regained the ability to feel and move their limbs in space. It reminds one of the sudden

restoration of perfect radio reception when enemy efforts to "jam" a broadcast have ceased.

Discussion

I have used this radio comparison because it seems to me that the phenomena of transient quadriplegia suggest a physiologic, as contrasted with an organic, change. When I seek for an explanation of these phenomena among the many experimental investigations of cerebral concussion I am inclined to reject the theories based on "synaptic disruptions," "deformation and stretching," "neuronal damage" and even the "reversible molecular reactions" postulated by Denny-Brown and Russell. Each of these theories is based on the assumption that changes take place in individual neurons, while our cases seem to suggest a transient dys-synchronization. I find myself wondering if what we are recording may not be related to what von Monachow called "diaschesis," and to the interpretations of cerebral concussion now being advanced by Walker, Kollros and Case. These investigators propose the theory that "trauma adequate for concussion causes first an initial excitation with massive discharge of neurons of the central nervous system followed by an after-discharge. This results in extinction of the central nervous system activity with a decrease in the observable reflex phenomena." They support their theory by encephalographic studies which indicate that an initial electrical discharge of considerable amplitude is followed by rapid activity for 10 to 20 seconds after the trauma, and then there is a gradual decrease in electrical activity, before the normal rhythms are again established.

In commenting on cerebral concussion in its relation to amnesia, Andrew Ivy has written, "There can be no doubt regarding the fact that the loss of consciousness is due to the physical stress of stimulation. The loss of consciousness is too sudden to be accounted for otherwise. But how does the sudden application of the mechanized stimulus cause paralysis? Is it a molecular shiver and separation of synapses, or is it the result of over-stimulation fatigue, as in the case of electrical stunning and the epileptiform attack? I prefer to believe that the mechanical stimulus disorganizes the existing co-ordination of the reflex patterns, or neurograms, and causes either a cerebral dysrhythmia or hypersynchronization."

These interpretations of Ivy relating to cerebral concussion seem equally applicable to our cases of transient quadriplegia. When a high-velocity missile ploughs through a man's brachial plexus, its capacity for stimulating nerves, or perhaps its distant effects on the sensitive meninges of the spinal cord, could give rise to an overwhelming barrage of afferent impulses. It is my belief that this massive stimulation causes a temporary disorganization of the functional patterns within the neuraxis.

POST-OPERATIVE PULMONARY EMBOLISM

Lecture delivered at The Royal College of Surgeons of England
on
24th July, 1947
by

Professor R. J. V. Pulvertaft, O.B.E., M.D., F.R.C.P.
Professor of Clinical Pathology Westminster Hospital Medical School

THE PRESENCE OF large and well-organized clots of blood in the pulmonary arteries has long been recognized, but in spite of Harvey's demonstration of the mechanics of the circulation of the blood, it was left to Virchow, one hundred years ago, to explain their true nature. Since that time an enormous literature has developed around the subjects of thrombosis and embolism. They seem indeed to have attracted an attention greater than their clinical importance warrants, and elementary students of physiology are often a little puzzled to find so many of their masters weaving a tortuous and highly individual path through the polysyllabic mazes of blood coagulation. But the penultimate word on the question was said by Welch, in 1897, in Albutt's System of Medicine. Much that has been written since then has been a bungaloid growth rather than an architectural synthesis; on reading his excellent study, one feels again that students would be well advised to remember that there were great men before the Agamemnons of modern medicine.

There is no doubt that blood clots can and do form in the blood vessels of the lung. They can often be extruded at post-mortem in the form of thin worms; in poisoning by inhaled irritant gases they are a marked feature of the condition; and coagulation may extend in pulmonary vessels from a small embolism. We are here concerned, however, with clots of blood which move to the lung from their distant site of formation, and only with a special group of these.

In a great many disorders venous thrombosis occurs, and in all these pulmonary embolism may follow. For example, my own experience covers a severe epidemic of typhus fever in Egypt, where venous thrombosis, and indeed gangrene from arterial embolism were prominent. We find similar cases in enteric fever, and in all marantic conditions. A second group, thrombosis and embolism following septic abortion and child-birth, is well represented; a third is related to chronic cardiac valvular disease. A feature of all such cases is that there is no common age factor. Indeed, the vast majority of cases of pulmonary embolism occurring in young persons come in one or other of these groups. Young persons do not suffer from post-operative pulmonary embolism.

An intermediate group may be mentioned in passing. Thrombosis and embolism occur, fortunately rarely, as complications either of varicose

veins, or of their treatment by sclerosing injections. In spite of the fact that, at Westminster Hospital, there has for a long time been a very active varicose veins clinic, I can only trace two fatal cases of pulmonary embolism. But this small group of patients are, owing to the nature of their primary disorder, either middle-aged or elderly.

We are concerned at present with a clearly demarcated group, the embolism which follows within a fortnight of a surgical operation, and which is usually fatal. It is among the most dramatic of clinical entities, impressing itself forcibly on the memory of student, nurse and surgeon. Once developed, treatment by surgical intervention has only very rarely been attempted, or if attempted, been successful. Our only hope for its mitigation lies in prophylaxis.

Pulmonary embolism, in general hospitals, is the immediate cause of death in approximately 2 per cent. of all post-mortems. My own series is given in the table; of 4,750 post-mortems, 84, or 1·8 per cent., were due to this cause. Of these, only 19 had not suffered recent operation. All the young cases, which were cardiac or obstetrical, came in this group; and even including these, the average age of the patients was 57. I have not further analysed these cases in the table, but features other than age are noteworthy. The patients were in the main suffering from chronic and debilitating conditions, and had been long bed-ridden; the operations were often minimal, and included two cases of sigmoidoscopy and two of needling of tongue for carcinoma.

I have said that in a number of cases clots which move to the lung after operation are massive, and almost immediately fatal. This is, of course, not always so, and where the primary thrombosis is in small veins, such as the prostatic plexus, multiple small infarcts may occur. It has been suggested by a colleague that the so-called post-anaesthetic broncho-pneumonia may be of this nature in certain cases. This radiological diagnosis was first made an X-ray film; a typical infarct was found at post-mortem, when death later occurred through massive pulmonary embolism. It is proposed to examine this possibility more carefully; but at present the typical clotted-blood sputum of pulmonary infarction is the main laboratory criterion of the condition.

Before discussing in more detail the site of thrombosis in these cases, we may properly revive our knowledge of the histological changes which occur when blood clots in a vessel. The earliest clots show the formed elements of circulatory blood enmeshed in stellate fibrin filaments; the elements are segregated; but very roughly they are in their normal relative numbers, except for the increased proportion of platelets. It is easy therefore to identify red blood cells in strands, with intervening clefts of platelets; leucocytes are usually concentrated as margins to the platelet cleft. The increased number of platelets is significant, and some observers state that during surgical operations they increase in circulating blood. However, in my opinion only very gross changes in platelet counts are noteworthy, as few clinical pathologists consider their life work complete

until they introduce a new method of counting them. We are entitled therefore to suppose that the general law of medical science holds good, namely, that the more ways there are of doing a thing, the more certain it is that there is no good way.

In a very short while changes take place in the clot. It becomes more tightly adherent to the vascular wall, in part through greater density of the fibrin, but mainly through vascularization. Small very thin walled vessels make its structures a fine sponge. Platelets are no longer recognizable, either in massive clefts or as individual entities, and wandering macrophages permeate the whole clot, with an increase of polymorphs. Coincidentally the formed red blood cells disappear, so that a section no longer shows their original proportion to white cells. In a great many cases the clot is resolved, and complete vascular continuity is restored. In others, fortunately in very few, the whole clot is dislodged and moves as an embolism to its final site. In yet others it becomes converted into fibrous tissue, canalised by blood vessels. But if we consider how frequently thrombosis of large superficial veins occurs in modern intravenous therapy, and how rarely these veins show permanent occlusion, we must suppose that resolution of thrombi is the rule and fibrous organization or embolism are the exception. It must be admitted however that distinguished authorities believe that a thrombosed vessel never again regains continuity of blood flow.

The clinical aspects of post-operative pulmonary embolism are only too familiar. An elderly patient, suffering usually from a chronic and often malignantly neoplastic disease is confined to bed for weeks. An operation, often a minor one, is performed. During the next week convalescence is rarely normal; experienced nurses and surgeons with an eye to the condition note that there is often a rise of temperature, and that the patient is apprehensive, and frequently "difficult." I am personally impressed with the frequency with which these two features are present.

Death, in my series, has followed as early as one day after operation, but in most cases occurs ten days later. The patient is now more active, and the coincidence of death on the bed-pan is most striking. This has been explained as the mis-interpretation by the patient of visceral sensations caused by the movement of the clot from its site; it may also be due to the fact that the muscular activity of defæcation is the precipitating cause of the clot's migration. Death supervenes more often in minutes than in hours, with severe shock, and sometimes pain in the chest.

At the post-mortem we can nearly always find evidence of thrombosis in the veins of the legs, more commonly on the left side than the right. The left common iliac vein is crossed by the right common iliac artery, and some have supposed that this occasions the increased unilateral incidence.

It must however be remembered that the thrombus which is discovered in a large vein is the one which has not moved.

If the net is thrown more widely we find that a surprisingly large number of persons coming to post-mortem at or over middle age show venous thrombosis in the legs. For many years I have personally observed this, although I had earlier usually confined my examinations to the iliac and femoral veins. This, however, is no new observation ; in recent years it has been more carefully studied, and though the statistics are not uniform, since each institution tends to select its cases, the high incidence of thrombosis without operation is quite clear. If the examination is continued to the veins of the calf muscles and plantar regions, more than half of the subjects show thrombosis. The number who suffer embolism varies much, in one quite exceptional series being as high as 10 per cent.

Returning to our post-mortem cases, we find in one or both pulmonary arteries a massive thrombus. Often it straddles the bifurcation ; more rarely it is only found when the artery is cut open. Much nonsense is talked about the difficulty of recognizing ante-mortem clots. In a very large number of cases the blood is fluid except for the embolism itself, and the residual thrombi at the sites of formation ; but the embolism itself, with its pale colour, rough surface, and friable texture is self-declamatory to anyone who has seen a case. So called chicken fat clots, and currant jelly clots, are never embolic, but always locally formed and etiologically of no significance.

While it appears to be established that venous thrombosis is already present in at least half the patients coming to operation at certain age groups, we ought to consider whether this process may be extended and accelerated by any operative procedures. It appears that this is the case, since even the position of the patient at operation, as in the Trendelenburg position, may cause venous stagnation. I have wondered, too, whether the apposition of the calf muscles to the unresisting theatre table might be a factor. Certainly the use of a torniquet, often applied to the leg if an intravenous injection is given, might deserve consideration.

A second point, admittedly very highly theoretical, is the influence of sub-clinical bacterial infection. The staphylococcus produces a most active coagulase in vitro, and in modern conceptions this is a salient element in its virulence, since the organism is only infective to those animals whose plasma it coagulates. It is suggested with plausibility that the coccus surrounds itself with a protective barrier of fibrin. Since organisms can often be cultured from clots, this might conceivably be an element in their formation or extension. The staphylococcus and other organisms are also, and paradoxically, fibrinolytic, and their action might determine clot migration later. In very cursory tests I have not found organisms other than the staphylococcus to produce coagulation by a similar technique.

Some element of shock is present in a great many operations and the haemo-concentration resulting contributes to circulatory stagnation, and this to thrombosis. Blood clotting times, in my own observation,

are markedly accelerated during operations, often the most trivial ones; the greatest acceleration which I noted was in a hernia when the testicle was manipulated. Where any element of asphyxia intervenes, as it only too frequently does in anæsthesia, the clotting time is however more slow.

Again, the cutting or even manipulation of tissues inevitably releases thrombokinase into the circulation. The relationship between this and thrombosis at a distant site has been much disputed. Certain thrombotic phenomena, such as thrombo-phlebitis migrans, are often correlated with malignant disease; and every school-boy knows that femoral thrombosis in a middle aged man should always suggest gastric carcinoma. I have very frequently noted widespread thrombosis all over the body in malignant disease, and one possible explanation is the release of thrombokinase from necrosing neoplasms.

Since so many patients coming to operation have to undergo treatment with anti-biotics, it is disquieting to note that several recent workers have shown that both penicillin and streptomycin accelerate blood coagulation. It is common knowledge that continuous intravenous therapy with penicillin often causes a local thrombosis, but this is the case with all forms of intravenous therapy. An effect on the blood clotting complex is of a different nature, and in private conversations surgeons have expressed their view that this was the case even before laboratory confirmation. Cases of embolism have been attributed to this; it appears that the effect is found more frequently in some types of penicillin than in others. These drugs can clearly not be withheld, and all one can do is to appreciate the additional risk of embolism, and perhaps to consider even more carefully the use of anti-coagulant drugs.

Many surgeons of experience have noted a seasonal incidence of pulmonary embolism; indeed one is constantly observing that they come to autopsy in groups. In certain parts of America, one third of the cases occur in winter, and the smallest number in summer. This, if established as a general truth, might perhaps be correlated with a suggestion which I shall make later, namely that a clue to venous thrombosis may be found in a diminished arterial blood flow to calf muscles.

The prophylaxis of pulmonary embolism is largely outside the province of the pathologist. However, it is a surprising fact that whereas in twenty years of post-mortem examinations I have never seen a case in which femoral ligation was performed, this practice is universal in America. In one hospital alone it has been performed over 800 times, with only one fatality from embolism; the operation is considered within the scope of the resident staff. We must conclude either that the American surgeon is giving himself and his patient a lot of needless trouble, or that our native surgeons are in general omitting a useful, practical and simple measure.

The second type of prophylaxis is the use of drugs to control blood coagulation. The rationale of this method is that thrombi are believed to spread both peripherally and distally from their limited point of primary formation. All are agreed that small pulmonary embolisms are of no serious importance; in order to cause death a clot must be formed in a vessel of large lumen, such as the femoral vein or its main branches, or in the iliac vein. It is undoubtedly possible to establish that the veins in calf muscles are thrombosed. This is comparatively rarely established by the observation of oedema; certainly at post-mortem most cases of pulmonary embolism show no disparity in size of the legs. But it is readily established by palpation and the tenderness thus evoked, and the use of phlebography gives results still more conclusive. Phlebography also appears to establish that thrombosis is often steadily progressive.

There are two quite separate methods of controlling blood coagulation, by heparin and by dicumarin.

The mechanism involved undoubtedly differs. Dicumarin prevents the formation of prothrombin, and its action cannot be cut short; once administered only blood transfusion can restore the power of blood coagulation. Hence it must be carefully controlled by the estimation of prothrombin both before and after use, and the main danger in its use lies in a haemorrhagic state sometimes induced. It has been widely employed, but opinion is sharply divided as to its legitimate exhibition.

Heparin interferes with the blood clotting complex at more than one point. It acts for a limited time, though, as with penicillin, the duration of action may be much extended by the use of beeswax in the injection mixture. Moreover its action may be cut short by the use of protamine. This method has been intensively used by Gunnar Bauer in Sweden. Over 200 cases of thrombosis in the veins of the calf have been treated, and the mortality from pulmonary embolism was reduced to 1·5 per cent. from the previous level of 18 per cent. in a period of a few years.

My personal experience is small, and is confined to the use of heparin in thrombosis of all kinds. Its value appears to be unquestionable. The great difficulty at present is in obtaining supplies, which come largely from America and from the Continent.

One fact seems to be established beyond all reasonable doubt; that is, that the fatal embolisms are products of blood which has clotted in the veins of the leg. It seems almost equally certain that they begin in many cases in the deep veins of the muscles themselves. If we are to understand the underlying mechanism of pulmonary embolism, the clue is surely to be found in these peculiar and rather unexpected facts.

To these facts we may add that the subjects are nearly always elderly and long bed-ridden, in fact suffering from the marantic thrombosis to which Welch so often referred. How are we to correlate these features? Mere immobilization does not cause thrombosis or embolism. During the five years in which I carried out post-mortem examinations on wounded

Fig. 1
Venous thrombosis—Stage I

Fig. 2
Venous thrombosis—Stage II

Fig. 3
Venous thrombosis—Stage III

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Fig. 4

Pulmonary embolism, showing organized clot in pulmonary artery.

Fig. 5

Organized thrombus in femoral vein and in veins of calf muscle. From a case of pulmonary embolism.

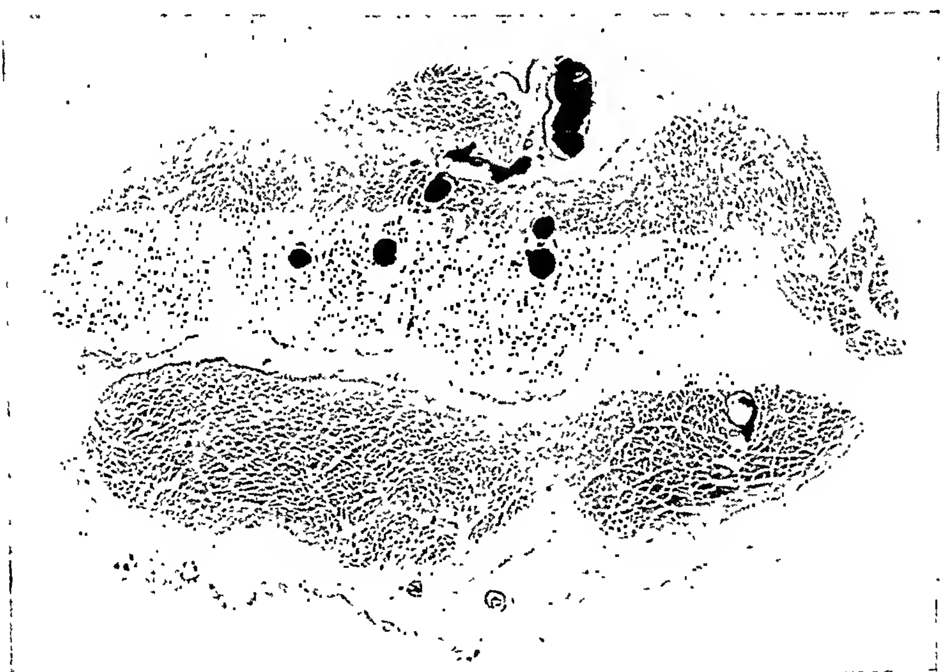

Fig. 6

Giant section of calf muscles, showing thrombi in deep veins. From a case of pulmonary embolism.

men whose limbs were encased in plaster, I can recall no case of pulmonary embolism; and on enquiry among surgical colleagues my experience was confirmed. These were all young and previously healthy men. In striking contrast was the incidence of pulmonary embolism among elderly people during the War, whose sole immobilization was a relatively short stay in air raid refuges, sitting on hard and uncomfortable benches.

I would like to suggest that the explanation is to be found in a very recent paper by Stoner and Green, who have revived and extended the pioneer work of Quastel and his colleagues. They have established that the amount of thrombokinase (thromboplastin) which can be extracted from the muscles of rats which have been made ischaemic, without completely occluding the blood supply is much greater than from normal muscle.

This finding seems to be most important. In elderly persons the arterial supply of the lower limbs is often very poor from arterio-sclerotic changes. It would seem that prolonged decubitus, or the additional interference with arterial blood supply produced by the conditions in air raid shelters should lead to an increase in the thrombokinase in the venous blood of the calf muscles. In no other part of the body do we find so consistently disease of arteries supplying large muscle groups.

The suggestion which I put forward is that owing to arterial stenosis there is ischaemia of calf muscles in elderly persons; this results in a localized production of thrombokinase, and under conditions involving venous stagnation thrombosis follows in the deep veins of the calf.

It has been shown that thrombosis in the veins of calf muscles, and femoral thrombosis, occurs in a large number of elderly persons who are bed-ridden, whether or not an operation is performed. It would almost appear that all marantic persons, especially all marantic elderly persons, are potential victims of pulmonary embolism. The essential problem is therefore the movement of blood clot from its site of formation.

It is improbable that only one factor is involved in this migration. It is well known that embolism most commonly occurs after a lapse of about ten days following operation; at this time the patient is showing increased convalescent liveliness. It has often been stated, too, that a distinction must be made between thrombosis and thrombo-phlebitis; if the wall of the vein is inflamed the clot is mechanically anchored, and embolism less likely. Lastly, a clot may form in a small vein in a calf muscle, and extend either distally or proximally. Serial sections of calf muscles show that this is the case, since it is easy to determine by microscopy the relative age of clots. In this way a clot may be firmly anchored at its site of formation, but be freely moveable in its proximal extension to the femoral vein.

It would be wrong to overlook the very significant work of MacFarlane and his colleagues on fibrinolysis in this connection. Liquefaction of clots has long been noted, and is described in the work of Welch.

MacFarlane has shown that whereas the serum of normal persons very rarely exhibits any fibrinolytic properties, operations of all kinds are rapidly followed by the appearance of fibrinolysis. Anyone who has read anything about blood coagulation will be prepared to find that this phenomenon is a complex one, complete with an inhibitor and an activator.

MacFarlane's work was begun before the war, and at that time was confined to post-operative cases. He noted even then the triviality of the operative procedures often involved. But latterly MacFarlane has found that fibrinolysis occurs even before operation, associated with pre-medication. Most surprisingly it occurs when the only stimulating factor is apprehension. The prospect of an operation is sufficient in itself to evoke fibrinolytic properties in serum, and an air-raid alarm proved adequate.

We are immediately forcibly reminded of the high incidence of pulmonary embolism in persons taking refuge from air-raids during the war. This was noted at the time, and attributed to thrombosis in the cramped limbs of the refugees. My own series includes one such case. We are struck by the coincidence of two factors—the arterial blood supply to the calf muscles diminished by sitting on hard benches, and fibrinolysis induced by apprehension. It is possible in this way to explain both the clot formation and its movement to the lung.

It is a remarkable fact, which I have long noted, that in most cases of pulmonary embolism the only blood clots are the embolism itself and those at the site of the thrombosis. Everywhere else the blood is fluid, and the difficulty theoretically experienced in determining whether a thrombus is of ante-mortem or post-mortem origin is not real. There are rarely any clots of post-mortem origin in these cases.

Obviously work must be done to determine the presence or absence of fibrinolysis in these post-mortems. I do not know of any; but recently in my laboratory fibrinolysis of very high titre has been found in cases of coal-gas poisoning, with fluid blood. All available evidence goes to suggest that if the blood at post-mortem is fluid it is because a fibrinolysin has been activated.

The fluidity of blood in many cases of sudden death was made use of by Yudin in his technique of corpse-blood transfusion, and it has been noted that in none of these Russian cases did pulmonary embolism develop.

We may therefore in conclusion attempt to form a hypothesis on the etiology of pulmonary embolism, more in order to orientate ourselves for further investigations than to claim that the problem is solved. Such a hypothesis might read as follows.

In a high percentage of elderly persons there is arterial disease of the extremities which causes ischaemia particularly in the muscles of the calf. In such patients too varicose veins are common.

If such patients become bed-ridden, a number of factors conspire to produce slowing of the circulation in the legs and thrombosis. These factors are immobility, nursing with pillows below the knees, as well as increase in thrombokinase production from muscular ischaemia. Thrombokinase may also often be increased from degenerative changes in the neoplasms from which many subjects of embolism and thrombosis suffer. A further factor which might induce blood coagulation is the presence of coagulase producing staphylococci in the circulating blood.

Hence a high proportion of elderly persons coming to operation are candidates for pulmonary embolism. During pre-medication and in the anxiety produced by their circumstances, fibrinolysin is formed, which tends to detach the clot from the wall of the vein. Its anchorage loosened, the ultimate embolism is precipitated by the mechanical forces brought into play by convalescent activity.

We may ask what further investigations may be made to throw light on these suggestions. It is clear that palpation of calf muscles before and after operation, is necessary to determine the presence of thrombi. Some may wish to continue then with phlebography.

A great deal more work should be done to determine the frequency of occurrence and titre of fibrinolysin, not only before and immediately after operation, but also in post-mortem blood.

The arterial supply of the legs in all established cases of embolism should be investigated, and the coagulation time in venus blood from the veins of the lower extremity might be an indication in such cases of excess thrombokinase.

A more critical view might be taken of all post-operative pulmonary complications. Areas of so-called broncho-pneumonia may not infrequently be small infarcts arising as embolisms from the veins of the leg.

Certain prophylactic suggestions arise out of these considerations, such as the avoidance of unnecessary decubitus, and care in pre-operative nursing to avoid precipitating thrombosis; massage and active movements might be encouraged. And if the physician or surgeon can bestow by his art a quiet mind on his patient, fibrinolysis may yet be overcome.

A survey of world literature makes one realize that in two prophylactic measures British medicine as a whole differs from Continental and trans-Atlantic practice. Neither venous ligation nor the use of anti-coagulants has achieved popularity among us. There may be good arguments against the use of either method; but an outside observer such as a pathologist cannot help noting that few surgeons have much personal experience of them.

But, as a last word, we should not exaggerate the importance of a condition which, undoubtedly dramatic, is often far from tragic. In my

series at least the majority of cases were men and women whose hour of death was not long to be postponed from the nature of their condition; and to whom death came, if suddenly, as a merciful euthanasia.

WESTMINSTER HOSPITAL

Post-Mortems—Pulmonary Embolism
1926-46

Total Post-Mortems	Pulmonary Embolism	% Pulmonary Embolism
4,750	84	1·8
Male	Female	Average Age
37	47	57
Youngest	Oldest	Post-Operative
22	77	65
Not Post-Operative	Operations Include Needling for Carcinoma and Sigmoidoscopy (2 Cases)	
19		

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THE USE OF D-TUBOCURARINE CHLORIDE IN ANÆSTHESIA

Lecture delivered at The Royal College of Surgeons of England
on
17th April, 1947
by

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THE SUBJECT of curare has developed to such an extraordinary extent during the past two or three years that it is now quite impossible to review it in any detail in one lecture.

So much work has been done on its chemistry, botany, pharmacology and its clinical applications that it is possible only to give the briefest outline and to emphasise some of the points which appear to me to be important.

Introduction and Origin of Curare

"Curare" is a name given to various highly poisonous substances used by the South American Indian tribes to poison their arrows. These tribes dwell in the regions between the Amazon and Orinoco rivers. The substances vary considerably in composition. Their story is well known and one has only time to mention the bare facts of their introduction into the civilized world. Sir Walter Raleigh was the first to describe them when he wrote about his discovery of British Guiana in 1595. Later the arrow poisons were mentioned by various missionaries, notable among them being the Jesuit Father d'Acugna, who, in his publication of 1642, described how he found in the Amazonian jungles "an abundance of venomous herbs, with which some of these natives make so subtile a poison, that their arrows being rub'd with it, never draw the least blood without taking the life at the same time."

The actual composition of these poisons remained for centuries a closely guarded secret but eventually during the nineteenth century such eminent botanists and explorers as Humbold and Bonpland (1821), Schomburgk (1857) and Waterton (1812), by virtue of personal observations carried out on the spot, were able to throw much light on the problem, and more recently the investigations of Mr. R. C. Gill (1946), an American who lived among the Indians for a considerable time, and Mr. Harold King, an English chemist, have enormously increased our knowledge on this subject.

Curare was prepared by the distillation of the barks of many plants. Some of these supplied the paralysing principle, others were added to

give the substance a suitable consistency, and finally other animal products such as the fangs of poisonous snakes and reptiles, ants and spiders, were added in an ignorant hope that they would increase the efficacy of the potion.

From the work of King (1935), Wintersteiner and Dutcher (1943), it seems clear that raw curare depends for its paralysant activity on the presence in it of one or more plants of two types. The strychnos toxifera of Schomburgk and the strychnos castelnaea both yield a physiologically active extraction. In the other group are many plants of the natural order Menispermaceae, chief among which is the chondodendron tomentosum.

In 1895 Boehm attempted a classification of crude curare according to the containers in which it was exported by the Indians. These containers were of three main types—a hollowed bamboo cane which contained "tube curare," a calabash or gourd containing "calabash curare," and an earthenware jar or pot from which came "pot curare." Boehm analysed these curares and found that he was able to obtain different substances from each variety. The substances were amorphous quaternary alkaloids with a high paralysant activity and crystalline tertiary alkaloids with practically no paralysant activity but which, in some cases, were toxic in other ways.

Variety of Curare	Type of Alkaloid	Name (Boehm)	Composition	Activity
Tube curare	Amorphous quaternary	Tubocurarine	$C^{19}H^{21}NO^{4}$	++++
	Crystalline tertiary	Curine	$C^{18}H^{19}O^{3}N$	+
Pot curare	Amorphous quaternary	Protocurarine	$C^{19}H^{20}O^{2}N$	+++
	Crystalline tertiary	Protocurine	$C^{20}H^{23}O^{3}N$	+
	Crystalline tertiary	Protocuridine	$C^{19}H^{21}O^{3}N$	+
Calabash curare	Amorphous quaternary	Curarine	$C^{19}H^{26}N^{2}O$	++++

The Table shows the Boehm classification of curare and the substances he obtained from it. Particular attention should be paid to tube curare. In this he found the highly active amorphous substance tubocurarine, which is the base of the substances Intocostrin and d-tubocurarine chloride, which are becoming of such extensive clinical use to-day, but he also found in it the very toxic tertiary base curine. This has a depressant action on the heart very similar to that exerted by digitalis. It is thus no wonder that crude curare was often too toxic to use clinically.

In 1935, King, of London, prepared from tube curare a crystalline alkaloid d-tubocurarine chloride. His work, for the first time, provided us with a substance of definite crystalline structure and composition and with constant pharmacological properties. This substance, prepared by Messrs. Burroughs Wellcome & Co. in a 10 per cent. solution, goes under the proprietary name of "Tubarine," and it is this product which has been used chiefly by us in England as an aid to anæsthesia.

In the United States, Gill had made available a large quantity of crude curare made chiefly from the chondodendron tomentosum. Messrs. E. R. Squibb prepared from this a total extract which was purified, biologically standardised, and put on the market under the name of "Intocostrin." Intocostrin is an amber coloured solution standardised to contain 20 mg. of crude curare to the millilitre. It has been shown by the American Council of Pharmacy and Chemistry (1945) that by animal assay 1 mg. of Intocostrin is equivalent in paralysant activity to 0·15 mg. of d-tubocurarine chloride. In clinical use it might be more correct to say that 1 mg. of Intocostrin produces an effect similar to that produced by 0·2 mg. of Tubarine.

Pharmacology

Investigations of the pharmacological action of crude curare had always been confused by its varying composition, but now the availability of these purer products has made possible more accurate observations.

Taken orally these substances have no effect in human beings, although some animals and birds, notably pigeons, are affected when the poison is eaten. It has been shown that this immunity in humans and most animals is not due to any action of the gastric or digestive juices but more to a slow absorption and rapid excretion. Curare is excreted in the urine and traces of curare activity can be found in the urine of animals and humans who have been treated with this substance. It is said also that curare is destroyed by the liver. The evidence for this is at the moment rather inconclusive and judgment should be withheld pending further investigations carried out with the pure substances now available.

The classical experiments on frogs, which Claude Bernard (1857) performed in the years following 1840, showed that the paralysant activity of curare was due to an interference in the conduction of nerve impulses from the motor nerve to the muscle and that this interference occurred at the myoneural junction. In the curarised animal both the nerve and the muscle are still capable of responding to stimuli, but the break in conduction occurs at the junction of the two.

The work of Dale, Feldberg, Vogt (1936) and Brown (1936) leads us to believe that on stimulation of a nerve to a voluntary muscle acetylcholine is produced at the neuromuscular junction, and that curare produces its paralysant effect by preventing the action of this on the receptor substance of the muscle. While on the subject it is useful to consider the

action of physostigmine, which is said to be the natural and physiological antidote to curare. Normally acetylcholine is neutralised by an enzyme, cholinesterase, present in the tissues and blood. Physostigmine or prostigmine prevents this neutralisation, and so allows an abnormal and excessive barrage of acetylcholine to play on the receptor substance; this may succeed in overcoming its inhibition by curare.

That is how curare produces paralysis, from the point of view of the chemical theory of neuromuscular transmission, but this action can also be regarded in the light of the electrical theory of nerve impulse conduction. If the changes in electrical potential which occur at a point in the muscle on stimulation of the motor nerve be recorded, a typical curve is obtained (Fig. 1).

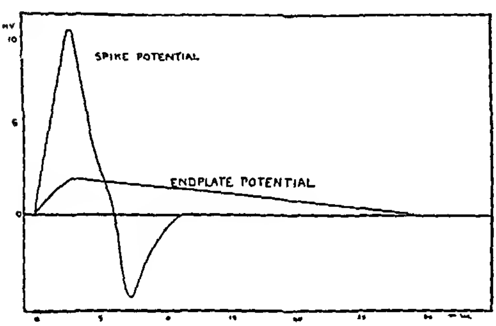

Fig. 1
Comparison between the spike potential of muscle and the end-plate potential recorded after complete curarisation—semi-diagrammatic. (From Fulton. Howell's Textbook of Physiology 15th ed.)

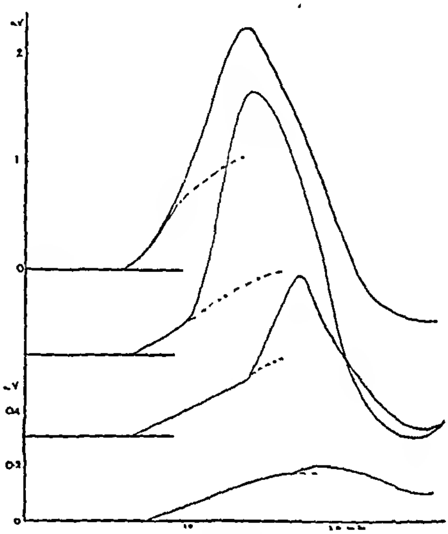

Fig. 2
Changes in the potential recorded at the end-plate region of a muscle as it becomes progressively curarised. Three things happen: 1. The spike potential decreases in amplitude; 2. It begins later in time; 3. The end-plate potential decreases in amplitude. Its supposed course is indicated by the hatched line extrapolating the first phase of the recorded potential. (From Fulton. Howell's Textbook of Physiology, 15th ed.)

This negative potential is called the "spike" potential owing to the shape of the curve. In the curarised muscle Eccles, Katz and Kuffler (1941) have been able to record the changes in the potential actually at the motor end-plate, that is at the myoneural junction, and a different type of curve is obtained. During progressive curarisation of a muscle it will be seen (Fig. 2) that the spike potential becomes progressively reduced, is later in onset, and that the end-plate potential is also reduced.

This produces a simple explanation of the curare action. By altering the time relationships of these potentials it may well be that the rate of rise in excitability in the motor end-plate, as indicated by the end-plate potential, is depressed by curare and the threshold necessary for stimulation of the muscle substance is never reached—the muscle is then completely curarised.

The truth is probably a combination of the chemical and electrical theories.

Injected intramuscularly the typical paralysant activity becomes apparent in about 20 minutes, but when given intravenously the action appears in 10 seconds and is fully developed in two minutes. The first muscles to be affected are the extrinsic muscles of the eyes. At this stage the subject may complain of tiredness, inability to keep his eyes open, and diplopia. The muscles of the face and tongue are next affected followed in turn by those of the neck, the deep vertebral muscles, those of the limbs and thorax, and finally the diaphragm with resultant complete respiratory paralysis. The animal or the patient at this stage, unless supported by artificial respiration, dies from asphyxia.

The point which must be stressed at this juncture is that although, in the average case, this sequence of events is roughly correct there are still variations in reaction. One subject, a volunteer, received 45 mg. of d-tubocurarine chloride, which is a very large dose, and although all respiratory activity was abolished he was still able to move his hands. There is, moreover, a marked overlap in the sequence of the paralysis.

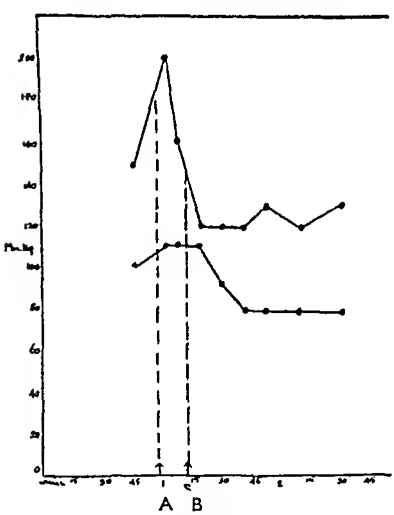

Fig. 3

Blood pressure recordings of a male patient aged 50 undergoing partial gastrectomy and anæsthetised with Thiopentone and d-tubocurarine chloride. To show the elevation of blood pressure due to under-ventilation.

It is very important to realise that any dose of curare which produces a clinical effect such as abdominal muscular relaxation also affects to some extent the intercostal muscles and the diaphragm, although they may not be completely paralysed and the patient may continue to breathe. The tidal air is thus always reduced and, although the patient may be kept well oxygenated by the administration of a high percentage of oxygen, the fact remains that his tidal exchange is insufficient, the ventilation of his lungs is thus impaired and inadequate, an increased tension of carbon dioxide in the blood occurs, the blood pressure rises and a troublesome oozing of blood in the site of operation may be seen. Moreover, such inadequate ventilation enormously predisposes to the occurrence of post-operative collapse and chest complications (Fig. 3).

This figure is a blood pressure curve in a patient anæsthetised with curare and thiopentone. At (A) the ventilation was inadequate, although the patient was still breathing, the blood pressure rises although the patient appeared to be perfectly oxygenated. At (B) full artificial ventilation was instituted with the restoration of the normal blood pressure.

These facts are too little recognised by anæsthetists and explain many of the troubles which have been experienced when curare is used. Aided respiration—that is, increase in the tidal exchange by manually squeezing the rebreathing bag of the anæsthetic apparatus—must always be carried out when curare is used.

Acetylcholine appears to perform some function in the transmission of nerve impulses through the ganglia of the autonomic nervous system, and possible through all the synapses of the central nervous system. In the same way that curare prevents the acetylcholine-receptor substance union at the neuromuscular junction, so too does it in the autonomic nervous system.

Although this is a secondary effect, exerted perhaps only in the presence of large doses, yet it may well be of importance clinically. In the first place, curare appears to depress markedly the laryngeal and bronchial reflexes, preventing that troublesome complication and bane of the anæsthetist, spasm. Secondly, the effect on the gut has been of some interest (Gross and Cullen, 1945). I have noted marked contraction and activity of the gut in some cases but in others, including most of those anæsthetised only with a barbiturate and curare, this irritability has been absent. It is difficult to come to any conclusion in this matter, as the gut reaction will vary with the premedication and the anæsthetic agents. All the anæsthetic and narcotic drugs, not to mention atropine, act on the autonomic ganglia, and it may well be that one is observing a summation of all these effects in conjunction with curare.

Salivation has been a feature in the human subject when curare has been given without adequate premedication with atropine. This can be very troublesome for the secretion is particularly thick, glairy and tenacious. For this reason atropine should always be given in good time and in adequate dosage.

The action of curare on the central nervous system still requires further elucidation. Whittacre and Fisher (1945), in America, reported a loss of consciousness after large doses of Intocostrin and actually performed operations on three patients without any other anæsthesia. It is difficult to see how, in the completely paralysed patient, these workers knew when consciousness was lost, and in human volunteers, using even larger doses, I have been unable to produce any signs of loss of consciousness or any interference with the sensory paths in the central nervous system. Anoxia would appear to be the cause of the unconsciousness in Whittacre and Fisher's patients.

However, curare does appear to produce some " potentiation " of the anæsthetic agents. We have noticed, particularly when the barbiturates

have been used as the anæsthetic agent, that their effect is greatly enhanced by the coincident injection of curare. This applies also to other anæsthetic agents and the American workers advise that when ether is used the dose of curare must be reduced to one-third of what otherwise would be given. The potentiation of the anæsthetic agents by curare, or of the curare by the anæsthetic agents, must always be kept in mind, and it is useful in that a light plane of anæsthesia can be maintained with the minimum quantity of toxic anæsthetic agent.

Present pharmacological opinion is that the liver and kidneys are completely unaffected by curare, but its action on the heart and cardiovascular system is a matter of some importance. The information available

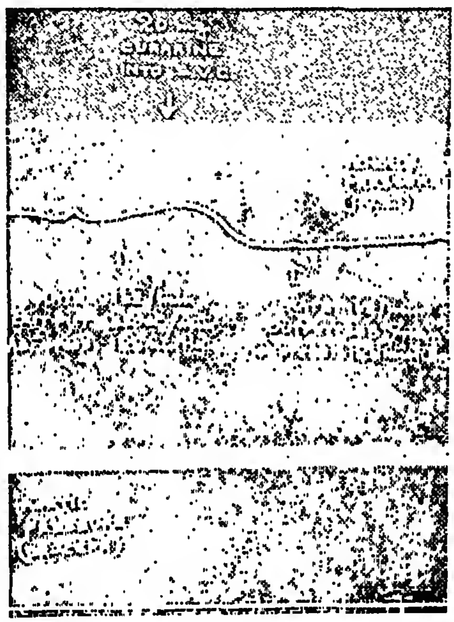

Fig. 4

Kymograph tracing of the venous pressure in a Starling heart-lung preparation (dog). Note the fall in venous pressure after the addition of d-tubocurarine chloride.

up to now has been of doubtful value, for one has never been quite certain which particular extract or preparation was being used. Certain extracts of curare, curine in particular, are known to be potent cardiac poisons. However, our clinical results led us to believe that the drug might have some effect on the myocardium. I have observed the effect of tubocurarine on the electrocardiogram in a number of cases in the human subject, and have estimated the result when this material is injected into the Starling heart-lung preparation in dogs. We can say that d-tubocurarine chloride produces no alteration in the electrocardiogram in

doses in which it is used clinically, and on injection into the heart-lung preparation in dogs, using a dosage vastly greater than anything ever likely to be used in humans, no effect whatever has been observed on the cardiac rate, output, or on the venous pressure, nor was there any interference with the coronary flow. The venous pressure is in fact consistently lowered in this preparation when curare is added (Fig. 4) (Gregory and Gray, 1947).

It must be emphasised that, in spite of this, curare must be used only with the greatest possible care to maintain full and very complete oxygenation, otherwise the patient's condition will rapidly deteriorate. Especially is this so in those cases having a poor myocardium, for they cannot cope with any sub-oxygenation. In clinical dosage, little or no effect can be observed on the blood pressure. Depression may be seen when a large dose of curare is injected quickly, especially if in association with a barbiturate (Fig. 4).

Rationale for the use of Curare in Anæsthesia

Before examining in detail the techniques which we have found to be most efficacious in the administration of curare it is first necessary to discuss the rationale underlying the use of this substance in anæsthesia, and the range of dosage which will be required.

Curare is used in anæsthesia for four purposes :—

1. To provide, using only very light anæsthesia, the muscular relaxation which is required for abdominal surgery;
2. To facilitate, in a light plane of anæsthesia, control of the respiration during thoracic operations;
3. To ensure freedom from laryngeal spasm during any anæsthesia;
4. To potentiate the anæsthetic agents so that light anæsthesia can be maintained with only minimal quantities.

This rationale calls for an entirely new conception of general anæsthesia. Many of our old ideas must give way to new. The age of deep anæsthesia with all its attendant evils has passed. The administration of heavy doses of the toxic anæsthetic agents to produce satisfactory operating conditions for the surgeon resulted in post-operative depression, shock, toxæmia often manifested by prolonged nausea and vomiting, and a high incidence of pulmonary complications. Now, when curare is used, the patients are given only minimal doses of the anæsthetic agents, just sufficient to keep them asleep. They are often awake at the close of the operation, are co-operative and fully conscious on return to the wards, they are able to cough effectively and breathe freely, facts which must reduce greatly the incidence of post-operative complications. They are for the most part singularly free from those unpleasant toxic sequelæ which have always resulted from the administration of a general anæsthetic.

The new conception of light anæsthesia and adequate curarisation to produce good operating conditions must always be borne in mind, for there is no more harmful combination than curare and deep anæsthesia.

Dosage and Technique of Administration

The dosage which is employed varies from individual to individual. The aged require greatly reduced doses as also do children, and whilst a dose for weight scale is useless in adults, in children it is of great value, for in them the muscle mass upon which depends the requisite dose of curare bears a more certain relationship to body weight. We have found that for children 2 mg. per stone body weight is a safe dose for induction. In healthy fit adults 15 mg. is used for induction, but in patients over 65-70 years of age 10 mg. is safer. Owing to the possible danger of idiosyncrasy and the variability in the individual reactions of patients, one-third of the induction dose, *i.e.*, 5 mg. in healthy adults, is first given intravenously, followed by a pause of three minutes before administering the remaining 10 mg. In this way some assessment of the individual's reaction to the drug can be made. The usual reaction to this small trial dose is mainly subjective. The patients feel " drowsy," " heavy " or weak. There is a little weakness of the eye muscles but usually no definite ptosis or diplopia, and certainly no embarrassment of the respiratory function. Any reaction in excess of this is an indication either for abandoning its use in that particular patient or for modifying considerably the dosage, depending on the degree of over-reaction. Such exaggerated reactions will be seen in elderly patients, in those with a tendency to myasthenia gravis, and in the presence of true idiosyncrasy, which is rare, only one case having so far been reported.

It will be noted that the curare in our technique is given first before the induction of anæsthesia. This is done for two reasons. The first is to allow the effect of a trial dose to be assessed, and the second is to assure that the effect of the curare is present simultaneously with the induction of anæsthesia. Laryngeal spasm is thus avoided and an airway or endotracheal tube can be inserted at once. As the induction of anæsthesia is always with an intravenous barbiturate and follows immediately on the administration of the full induction dose of curare the patient experiences no discomfort.

After the initial dose small increments of d-tubocurarine are given as required. There is a cumulative effect, so that the subsequent doses are much smaller than the initial dose.

Three main techniques are employed. The first is used for the induction of anæsthesia, for endoscopies such as bronchoscopy, œsophagoscopy or laryngoscopy prior to endotracheal intubation. This technique is also useful for cystoscopy or sigmoidoscopy in patients who are resistant to ordinary doses of the intravenous barbiturates.

After the intravenous injection of the dose of curare, 2-3 ml. of sterile saline are injected followed immediately by 0·5 g. of thiopentone. After this injection the respiration becomes very shallow or may cease altogether, the jaw is completely relaxed. Respiration is usually resumed before any degree of cyanosis or harmful anoxia can occur. The pulse rate, respiration and colour of the patient must always be under observation and oxygen must be administered. This latter is most easily done through the side tube of a bronchoscope, through a catheter introduced into the trachea in the case of œsophagoscopies and in other cases through a pharyngeal airway. At any time any cyanosis must be countered by the immediate institution of artificial respiration.

With this technique patients usually recover their protective reflexes and have full respiratory function in seven to ten minutes: but should this not occur they are retained in the theatre until there is no longer any fear of respiratory depression or obstruction. If necessary prostigmine is given. For prostigmine to be effective it must be given in adequate dosage. 3-5 mg. is the usual dose given together with atropine gr. 1/50 in order to overcome the undesirable parasympathomimetic effects. With this technique all the reflexes are present at the end of the examination which is a feature of great value in bronchoscopy, especially if a biopsy has been taken.

For longer procedures after the induction of anæsthesia the patient is maintained in a light plane of anæsthesia using one of the intravenous barbiturates, usually thiopentone. The Tubarine produces the necessary relaxation or control of the respiration and at the same time by its "potentiation" effect reduces the amount of the barbiturate which has to be used so that there is no delay in recovery. After the induction has been carried out in the way which has been described, an airway or endotracheal tube is introduced and the face-piece of a closed circuit anæsthetic machine fixed in position. Further doses of curare or barbiturate are added as required. It is usually necessary to give 5-10 mg. before the peritoneum is opened or, in the case of thoracic operations, just prior to the opening of the chest. It is desirable to deepen the anæsthesia slightly when there is excessive manipulation or any stimulation of the deep abdominal or mediastinal reflexes. This is best achieved by the

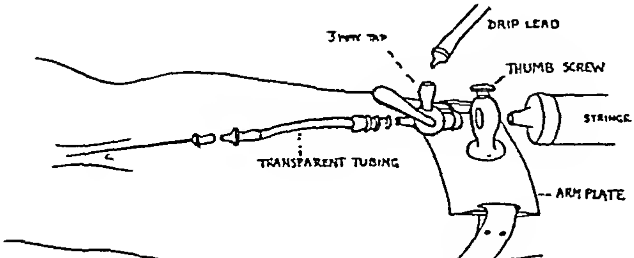

Fig. 5
Three-way tap and arm support (Halton)

addition of a little cyclopropane to the circuit. As soon as the stimulation ceases the anæsthesia can be lightened quickly, so that there is no undue depression of the patient or delay in recovery.

As solutions of tubocurarine and the barbiturates are incompatible and a precipitate is formed when they are mixed it has been necessary to devise special apparatus for their administration. Two types of apparatus are used. The first is simple (Fig. 5), and consists merely of an arm-plate, three-way tap, and a piece of transparent tubing. To use this an arm must be available and as this is not always possible a more elaborate apparatus has been devised (Fig. 6). This consists of a special combina-

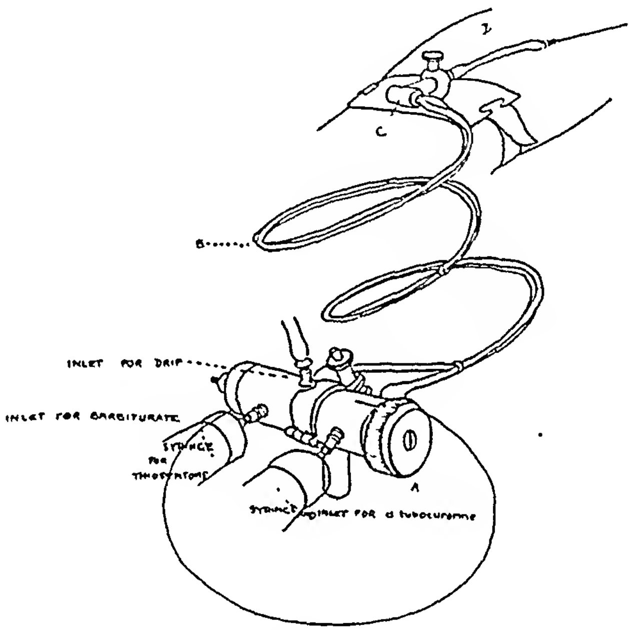

Fig. 6
Remote control tap (Gray, Osborne)

tion tap with inlets for an intravenous continuous drip, the curare and the barbiturate. The barbiturate passes down one tube and the drip through the other. The tubocurarine is put into the drip side of the apparatus and mixing is thus avoided. Owing to the firm fixation of the needle by the arm-plate the arm can be placed in any position, usually by the side of the patient.

If it is not desired to give continuous barbiturate anæsthesia the procedure is the same but one uses only the inhalational agents.

Some writers have suggested the use of a preliminary induction dose of tubocurarine with the maintenance of curarisation by a subsequent intramuscular injection. The effects of such an intramuscular injection come on after an uncertain interval and last for an indefinite time. As the aim is to produce curarisation only when it is required the intra-

muscular route would appear unsatisfactory on *a priori* grounds, and one which must give rise to trouble.

If you will allow me, I must repeat once again that control of the respiratory exchange is essential when this substance is used in order to ensure that oxygenation is adequate and carbon dioxide eliminated. This control is best attained by use of a closed circuit. The circuit must be completely free from leaks and the application of the anæsthetic mask to the face made really air-tight.

As has been pointed out, when tubocurarine or Intocostrin is used in effective dosage the tidal exchange is reduced and must be restored by rhythmic manual compression of the rebreathing bag of the anæsthetic machine. Adequate ventilation of the lungs is always possible through a pharyngeal airway of good design. Endotracheal intubation is, however, probably advisable as a routine when beginning to use this technique and it must always be employed in the following cases.

First, when there is any gastric or intestinal obstruction or when such a condition might be suspected. One of the dangers is an insidious or sudden regurgitation of stomach or intestinal contents with their subsequent aspiration into the bronchial tree. The œsophageal muscles and sphincters are relaxed by the tubocurarine and thus such an accident is facilitated. This has proved a real danger against which one must always be on guard.

Secondly, in thoracic operations where bronchial occlusion or suction drainage is likely to be required.

Thirdly, where the site or nature of the operation precludes the use of an anæsthetic mask.

Fourthly, where there is tracheal or laryngeal obstruction, and finally, when an overdose has been administered or there are other difficulties.

Two problems remain to be considered. The ordinary signs of anæsthesia are modified by the use of tubocurarine. The eye reflexes are sluggish and the respiratory signs are invalidated but three indications of a lightening anæsthesia remain. There is no danger of a patient becoming conscious during the operation and being unable to move because of the paralysis. In the doses which are recommended complete paralysis will not ensue and a lightening anæsthesia will be indicated by slight movement of a limb or a tendency to phonation. There may also be an increase in the respiratory rate and depth. If respiration has been completely abolished a rising pulse rate will indicate an inadequate anæsthesia. The need for the administration of more curare will be indicated by unsatisfactory operating conditions, by an increasing depth of respiration and by the degree of resistance to pulmonary inflation by pressure on the rebreathing bag.

One tries at the end of the operation to have a conscious patient and one with full and adequate respiratory function. For this reason it is preferable to obtain relaxation for the final closure of the abdomen by deepening the anæsthesia slightly with cyclopropane rather than by the

administration of more curare. Very little deepening is required as the effect of the curare which has already been given is enhanced by the further administration of an anæsthetic agent.

A marked feature has been the freedom from shock in these patients, and this despite the lightness of the anæsthesia, provided that it is deepened a little when there is gross stimulation of the deep reflexes. It has been suggested that curare gives some protection against shock. I do not believe this, but am sure that the fact that the patient's vital centres are less depressed when light anæsthesia is used and that as a result these, particularly the vasomotor centre, are better able to cope with any circulatory changes which may occur.

Tubocurarine is, I believe, a notable advance in our specialty, and one to which already very many patients are indebted for their lives, but it must never be forgotten that this is a very potent and dangerous drug and one having a profound and significant effect on the respiratory function. While the only two absolute contra-indications to its use appear to be the presence of myasthenia gravis or organic respiratory obstruction, it should never be used by those who are not used to dealing with the apnœic patient. The results which can be obtained fully justify the time spent in studying and gaining the special experience which is necessary.

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OPERATIVE PROCEDURES IN POLIO-MYELITIS

Lecture delivered at The Royal College of Surgeons of England
on
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by

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THE SUBJECT of the possibilities and limitations of operative surgery in the treatment of polio-myelitis is a wide one and in this lecture it is only possible to sketch its outlines. One aspect need only be mentioned to be dismissed, *i.e.*, the correction of deformities, because with early diagnosis and modern physio-therapy, including modern light, scientific splints, deformity should never occur. But it is not enough for conservative treatment to be begun early, it must be persisted in for very long periods and regular supervision by an expert for years after return to normal activity is desirable, because muscles which have shown *no evidence of paralysis* may remain for life *subnormal* in their capacity to respond to stress. Conversely, muscles which have appeared *completely destroyed*, may, if given favourable mechanical conditions for an indefinite time show very useful *return of power* after periods as long as ten years.

We may dismiss the subject of correction of deformity by saying that if bones have been allowed to grow out of shape, they can be straightened, like any other deformed bone, by a simple osteotomy; but it should be remembered that they are likely to be poor in blood supply and in lime content and therefore must be splinted for extra long periods. Similarly, a contracted joint can usually have its capsule and shortened muscles stretched gently by simple forms of traction, or by a succession of plasters, each applied with the maximum easy contraction at that time obtainable: but if the initial cause of the deformity persists, such as permanent paralysis of one group of muscles, the contracture of the opponents will recur unless some stabilising mechanism of splint or operation is added.

Forcible correction under an anæsthetic is likely to be dangerous in many of these cases because the decalcified bone may break before the short inelastic muscle or capsule yields; then one has two deformities to correct instead of one.

Another type of operation, which should be regarded as of historical interest only is *amputation*. In days as remote as those of the Etruscan vases unfortunate patients dangled round with them a deformed, stunted lower limb, of no weight-bearing value and such would have benefited

by removal of the encumbrance and fitting of a good artificial limb, instead of the kneeling peg shown on the vase. Such cases are rarely seen now-a-days. As long as deformity is prevented, much shortening is rare and can usually be dealt with by supplying a moderate cork-raise to a boot or shoe.

Before considering in detail the operations suitable for particular types of paralysis, it is best to review shortly the commonest and most generally valuable types of operation at our disposal.

The primary objective of all these operations is restoration of balance, either in a single limb, or in the body machine as a whole. It cannot be too strongly emphasised that before undertaking any such procedure, one should examine the whole individual, regarding him as a single machine with all its parts interdependent. The operation should be planned to check any early tendency to deviation in a direction mechanically unfavourable, or to restore equilibrium that has been lost, *e.g.*, if toes or spine are gradually becoming deformed, to fix certain joints which will check the deviation. The procedures available for this purpose are as follows :—

1. Re-arrangement of unparalysed muscles, so as to make one take over the function of a paralysed one, or to counteract the unbalanced pull of a large undamaged group, *i.e.*, active transplantation of unparalysed muscles. The use of tendons as passive slings has been found only of transient benefit, as once the tendon ceases to be stimulated by its living fleshy belly, it becomes atonic and slowly gives way, so that most operations of that type have fallen into disrepute.

2. Arthrodesis of joints, *i.e.*, induction of bony ankylosis, whether by mere erasion of articular cartilage, as in Dunn's tarsal fusion, or by bone-graft as in spinal fusion for scoliosis. These operations are extremely valuable for regions where *stability is essential* and the range of movement lost can be compensated by other regions. The fusion operation is unsuitable when stiffness of the part interferes with common actions, *e.g.*, a stiff straight knee is inconvenient for sitting and a stiff bent one makes walking almost impossible.

In some regions bony union is very difficult to attain, *e.g.*, in the decalcified bones of a flail hip-joint with all its muscles lost and its ligaments lax and wasted. Even the use of some auxiliary such as a Smith-Peterson nail does not guarantee permanent stability, for the atrophic bone loosens round the nail if strain is put on the joint and a ball-and-socket joint is subject to constant strains in varied directions.

A point often overlooked is that one stiff joint demands increased mobility and therefore increased muscle-activity at other levels. This usually developes after operations on tuberculous joints, for the patient's muscles are normal and readily hypertrophy in response to stress, but after a severe attack of polio-myelitis very many unparalysed or apparently recovered muscles may lack the power to hypertrophy.

Therefore stiffness of ankle, knee or elbow joints may be associated with admirable function in healed tuberculous cases, but in the writer's experience, fixation of these particular joints is apt to give a poor result in cases of polio-myelitis.

On the other hand, where the knee and elbow are very unstable, they can be made useful by light supports with locking hinges, so that the joint can be used either fixed or bent. It should be noted that if the foot and hip muscles are strong, the patient can control the knee in ordinary walking without external support whereas if the hip is really weak, it must be supported somehow. The type of splint, which usually suffices is the Thomas's walking-calliper, in which the ring steadies the gluteal tendons, such as the wrist-strap enables a weak wrist to play tennis. In addition, if the calliper fits well the patient steadies the tuber ischii on the ring while transferring full weight to the weak limb. In adults the same support is given by the moulded leather top to the iron, but in growing children it does not allow constant easy adjustment as the ring does.

When the hip, knee and foot are weak, the calliper is essential and it is seldom worth the patient's while to submit to operation on the foot, but if knee and hip are steadily recovering, a stabilising operation on the foot will often accelerate their improvement by giving the weak muscles a fixed base ; while conversely an unstable foot may delay their recovery by introducing unsymmetrical stresses. The decision when to operate on the foot in such cases depends on a careful analysis of all the factors involved. Contrary to widespread opinion, age has little influence on it. If the bones are soft from early youth or prolonged disuse, the foot must be supported for long periods after the operation by an accurately moulded support inside the boot, whether of leather, celluloid or perspex. This support often makes up for the smallness of such a severely paralysed foot and enables the patient to wear a pair of stock boots ; without it the small foot would slip about in the loose boot and deformity slowly recur, for bone is not a fixed structure but a growing tissue, yielding continuously to the forces which act on it. This latter function of bone is sometimes overlooked by those who carry out bone operations. An operation which is planned on physiological lines to utilise this quality of bone, may show little dramatic improvement in the early stages, but may ultimately induce the formation of great masses of new bone. This remark applies particularly to grafts of the tibial crest, a piece of bone of great initial rigidity, but poor vascularity, so that it shows strikingly in early X-rays after operation, but does not give permanent stability until its high lime content has been absorbed and replaced by more vascular bone mesh. During such a process, a stage of considerable softening may occur long after the operation and the patient, who has complete confidence in the stability of the grafted region, will risk sudden stresses, which may allow the most unexpected late fracture. On the other hand the spongy tissue of the tarsal bones, even when decalcified by severe polio will supply massive bony union provided the stresses to which it is subjected are

allowed to inerease gradually and steadily. For this reason the Dunn's type of " triple " arthrodesis of all the tarsal joints has given more permanent results than the attempts to fix ankle and tarsus by a tibial peg passed upwards from the sole through a drill hole.

As already remarked, if all the *tarsal joints are stabilised*, so that lateral instability of the foot (inversion and eversion) at the subastragaloid joints, and dropping and adduction at the mid-tarsal region are exeluded, then it is desirable to leave about the same range of ankle movement as is supplied in an artifieial limb.

As the late Lambrinudi pointed out years ago, if the line of eut through the *astragalus* is planned judieiously, plantar flexion at the ankle can be cut down so mueh that a few remaining weak museles can control the rest and so some " spring " is left in the foot. This is an essential part of the Dunn's operation, as is the pushing backward of the whole foot below the astragalus to put the leg bones nearer its centre and thereby reduee the leverage of the muscles whieh are causing footdrop. Some of the late results of tarsal arthrodesis which one eneounters show a lack of appreeiation of these two principles.

When the foot is a very long one it may be wise to supplement these steps by a *bone-block* behind the ankle-joint, aeting in the same way as the metal stop used to check excessive swing of doors. This ean most conveniently be made by trimming the seaphoid, whieh is usually removed in the tarsal operation, and implanting a wedge of it into a noteh made on the top of the os caleis immediately behind the ankle. If the cartilage is left on the side of the seaphoid next to the ankle ligaments, there is little fear of bony ankylosis at the top end and a very good stop results, which hardens more and more in course of time.

From these considerations it follows that in the *lower limb* the region which benefits most from arthrodesis is the foot, and of the foot joints, the whole tarsal mechanism, though it is rarely necessary to fix the tarso-metatarsal joints.

Another useful fixation operation in the lower limb is that of the dropped abducted *great toe* in complete paralysis of the extensors and short sole muscles. No transplant will restore function in this type, whereas fixation of the first metatarso-phalangeal joint in slight dorsiflexion will make for good walking. It is most stable if a step is cut in eaeh bone and the phalanx displaeed back on top of the metatarsal, so shortening the toe.

The other toes cause most disability when they are clawed and corns form on top of the proximal interphalangeal joints. After correction of tension in the soft parts, it is best to fix these proximal joints in a straight position, which can be done through a half-inch incision at the side of the extensor tendon, by chewing up the cartilage and bone ends with a sharp awl and then anchoring the soft parts by a deep silkworm-gut stitch. Even if the union allows relapse into slight flexion, as the soft callus is apt to do, the toes no longer ride over one another and the relief

is long-standing. If the operation allows time for overstretched intrinsic muscles to recover, then the result will be excellent. It is not always remembered that the functional position of the toes to limit jars to the foot mechanism is one of flexion at the metatarso-phalangeal joints and extension of the interphalangeal ones, *e.g.*, like the hand in a wide grasp with flexed knuckles. This function depends on integrity of the *intrinsic muscles* in each case and these muscles while rarely affected in the hand by polio-myelitis though frequently in neuritis and nerve trauma, is common as a late result of polio-myelitis. Indeed the better the recovery of the large muscles of the limb, the more readily can the patient put strain on the intrinsics, especially if he walks during convalescence in soft shoes which do not protect the sole from asphalt floors and roads.

In the *upper limb* conditions are reversed. It is stability of the upper end, the shoulder joint, which is all-important while at the lower end where small, accurate movements are important, transplants have a good field.

The *thumb*, like the great toe may become tiresome by constant flexion, but it is the end joint which requires fixation and it like the small toes can be fixed by a drilling operation ; if the thumb is contracted, in adduction, so that its tip cannot be opposed to the index and other fingers, it has been found that fixation of the first metacarpal at an angle of 60 degrees with the second, provided it is kept at right angles to the palm (not extended in the plane of the palm), function will be good for delicate movements like picking up a pin. But a strong grip depends on the powerful Adductor Pollicis, which is thrown out of action by firm wedging of the first and second metacarpals apart as occurs after use of a tibial peg to splay them out. On the other hand if the metacarpo-carpal joint alone is rawed and stiffened, there is enough play in the carpal and wrist joints to allow the Adductor to act fairly well. This less stable arthrodesis is usually best supplemented by some form of transplant, whose technique will be referred to later.

It has already been pointed out that the *elbow* is left *movable* and indeed if the shoulder is stable, the patient can usually manage to control the elbow for all but heavy weight-lifting jobs.

The *shoulder* is one of the joints whose fixation by operation gives one of the most dramatic results, for if its muscles are completely gone, the patient cannot bring even a good hand into a useful position, but it dangles helplessly at his side. If the deltoid is gone and the adductors fair, their unopposed action will gradually bring the limb nearer and nearer to the side with ever-diminishing function. If the shoulder is fixed to the scapula by operation, then good scapular muscles will take over the movements of abduction and some rotation. The most desirable angle of fixation is a subject of disagreement amongst surgeons, but the writer has found that if adults are fixed in 60 degrees abduction between the scapula and humerus, this diminishes in course of time, but allows

them always to bring the limb away 90 degrees from the trunk. In children the soft bones yield to gravity for years, so it is best to fix the limb at operation at about 90 degrees. The ultimate result depends less on the surgeon than on the reserve capacity of the scapular muscles to take on extra activity. If they are strong the limb may appear almost normal; if they are fibrous its range may be limited by them. However, the improved circulation in the limb when it ceases to dangle from its soft parts with blood vessels on the stretch justifies operation in cases which look at first unfavourable.

Other operations of less wide application are the following :—

3. Tenotomy, mostly applicable to contractures of the toe extensors in association with stiffening the interphalangeal joints. Although the flexors are somewhat tight also in such cases, it is best to leave them intact to act as the fulcrum against which to fix the stiffened toes, or the joints may turn out flail instead of fused.

Tenotomy of the tendo Achillis is seldom advisable, because mild shortening can be overcome by stretching in plaster, a series if necessary, which does not weaken the tendon. Contrary to one's expectation, it is the weak degenerate tendon which shortens, failing to keep pace with rapidly growing leg bones; therefore it is better to have it a little tight than too weak. The long heel (calcaneus) deformity is far more disabling than a mild foot-drop (equinus).

The only other Tenotomy likely to be called for is that of a shortened sterno-mastoid, which sometimes follows paralysis of one or both of these muscles. Again it may be the weaker muscle which is fibrous and inelastic and fails to grow.

4. Operations to compensate for *inequalities of growth* in the two lower limbs. In the writer's experience shortening of one lower limb after severe paralysis does not reach the serious degrees found after bone infections such as tubercle and acute osteo-myelitis, in which premature union of one or more epiphyses leads to differences of from 6 ins. to 9 ins. in the adult limbs.

Some of the most weakly limbs continue to grow equal to their sound neighbour but occasionally a limb without severe paralysis lags several inches.

The measures at our disposal are :—

(*a*) Checking growth on the sound side. This seems to the writer a sound procedure provided the cases are selected carefully. It is not worth disturbing the sound limb for differences under 2 ins. in young children, for many of these limbs tend to catch up by half to one inch in later years and 1 inch can always be compensated by footwear which is not unwieldy.

Differences of 3 ins. and over are serious for the patient and if they are present under 10 years of age and if an annual lag has been recorded

there is a risk of very gross differences when the good leg has gained up to 6 ins. or more, by the end of lower limb growth.

Again after fourteen years of age, some limbs do not grow much more, all the gain in height being in the trunk; therefore operating on one epiphysis at this age to check further growth may be futile. Many factors have therefore to be weighed, such as child's previous rate of growth, family stature, conditions of the epiphyses in femur and tibia each side as shown in skiagram. If those on the paralysed side are not joined, there is good hope of further growth; if those on the sound side are already joined, there is no point in operating.

It has been reckoned that causing premature union of femur or tibial epiphysis is equivalent to abolishing from 3 ins. to 4 ins. growth in each, but the measurements are empirical, as there are enormous variations in individuals and in the ages at which most rapid growth occurs.

(*b*) Lengthening short bones has been done successfully by certain surgeons, but the operation is one of technical difficulty, not only on the table but in terms of after-care, for the accompanying shortness of soft parts, particularly nerves and blood-vessels makes it essential after dividing the bones to carry out the actual lengthening very gradually otherwise further paralysis, trophic changes and even gangrene may occur. It is extremely difficult to control alignment accurately with the soft bones and fibrosed tissues of these badly paralysed cases, particularly in the tibia and fibula. The muscles of a normal individual play an important part in restoring good alignment, a point often overlooked when a polio case fractures a limb. Further, the decalcified bone is even more slow to unite when its ends are continually drawn apart.

5. Another operation of very limited application is Sympathectomy, either cervical or lumbar, carried out with a view to increasing the blood supply to a limb which suffers much from chilblains, especially those that result in trophic ulcers, slow to heal. Such cases are not specially common and in the clinics where this operation has been extensively used studies of late results have shown a disappointing tendency to relapse after dramatic improvement for a year or so. Again some of the good results attributed to it might have occurred spontaneously.

The writer has found that when the patient's general activity is restored by suitable local measures to a limb, there is a steady improvement in circulation and trophic aspects especially if certain precautions are taken in autumn to keep the limb warm before severe weather sets in and to improve its circulation by contrast baths and by a course of small doses of ultra-violet light.

6. Grafting operations are chiefly applicable to the spine, but here again the excellence of the result depends on careful selection of cases. It is useless to stiffen a limited area of a spine, whose general axis is faulty, since the living bone of the graft will yield gradually under the stresses which have distorted the rest. Conversely, in a spine with multiple

lateral curves, if exact compensation of all the curves has been attained in a non-weight-bearing position, while only one curve fails to be held in the upright position, then a bone-graft may give permanent stability to the whole spine. It should be remembered that it is rarely practicable to find a tibial graft or bed of more than 8 ins. length and the operation is a serious one in patients who have poor trunk and respiratory muscles and usually compressed, displaced vital organs, so that a whole series of grafts is very undesirable. For this reason amongst others it is undesirable to " correct " the curves by pulling them out shallower, but most suitable to let them telescope together as much as possible, a method which Nature uses frequently, but needs some assistance from plaster-beds and exercises to compete with the best mechanics. A single C curve is less stable and more liable to produce ultimate disability than a whole series of curves provided that the centre of the neck lies over the centre of the perineum. Of course, if the abdomen is so paralysed that a corset is essential anyhow, it may not be worth grafting the spine, but if the corset still fails to check increasing failure of compensation so that the centre of gravity falls more and more on to one lower limb, then graft plus corset are indicated.

Again if the scoliosis has been induced by weakness of one leg, which cannot be used without a calliper, then provided the calliper balances the trunk correctly, no spine operation is necessary. In border-line cases, stabilising the spine may give a fixed point to the gluteal muscles and so favour their advanced recovery.

7. Operation for severe Abdominal Asymmetry. Usually, the abdomen can be controlled by a properly fitted corset, such as that designed by Goldthwait of Boston, but occasionally the recovery of one side is advanced and the other remains completely lax. This may start a serious lateral curvature of the spine, or gross rib deformity. In such a case, transference of the whole tensor fasciæ femoris muscle from its insertion at the knee upward to the umbilicus, if the weakness is iliac, or to the lower ribs, if the weakness is subcostal, may restore the balance completely, or in great part. The use of this muscle turned upside down, without disturbing its nerve supply was introduced by Hey-Groves to supplement partially paralysed glutei, but it seems to the writer inadequate for a complete gluteal paralysis, and those with partial recovery seem to get along quite well, provided the foot is stable and the knee fair, or good.

8. Severe instability of the hip-joint may occasionally demand operation and in such a case the writer has secured it by the Lorenz oblique osteotomy which is intertrochanteric, the upper fragment being held fully adducted while the shaft is angulated outward on it, care being taken that the foot and knee point forward. In the absence of strong muscles it may be necessary to hold each fragment by a nail. The most convenient is a Stiles's nail passed out through the skin and incorporated

in the hip-plaster. As these cases are poor subjects for operation shock can be reduced by operating on a hip-frame and merely adding an anterior plaster-shell to keep the hip abducted. When X-rays show that callus is uniting the ends, which may take four or more weeks, then a walking hip-spica should be applied under anæsthesia with very accurate control of the abduction to match the maximum on the sound side.

A few details of technique in the various operations referred to already may now be dealt with. The full description of the operation can be found in text-books, but a few practical points are worthy of mention.

(*a*) TENDON-TRANSPLANTS.

General principles, which are sometimes overlooked are :—

1. The *active muscle* which is to be given a new job must be strong enough for that job. It is rarely possible to find one which is equal to the paralysed muscle it replaces, but the ratio should be a reasonable one. Thus for a partial paralysis of the Tibialis Anticus, the dropping of the front of the foot and progressive tendency to claw toes can well be countered by moving the tendons of the Extensor Longus Digitorum back to the level of the metatarsal necks, so that they supplement the dorsiflexing power of the Tibialis, instead of merely hyper-extending the toes. It is not necessary to pass them right round a metatarsal, as in the original operation, but merely under a strip of periosteum. It is convenient to pass the outer pair inwards and the inner pair outwards under the bridge of periosteum and suture them together with linen thread (90 for adults and 120 for small children). If there is also weakness of the Tibialis Posticus, the other invertor, the extensors can be attached to the second metatarsal. If both Anticus and Posticus are very weak, there will be too much unopposed eversion and a bone operation is indicated.

2. The active tendon should be whenever possible *synergic* to the paralysed one. For instance, if the *Peronei* are moved to the inner side of the foot, when the patient wants to invert it they will automatically relax because they are direct opponents of the invertors. Alternatively, if one of the *hamstrings* is moved to the front of the knee to supplement a weak quadriceps, it will stabilise the joint for standing, because both groups contract normally together to fix the joint.

In the upper limb the *wrist flexors* contract synergically with the finger extensors and therefore give a good result when transplanted into them; conversely the *wrist extensors are suitable* to replace missing flexors of the digits, while the *Pronator Radii teres* gives admirable results when transplanted into wrist extensors. It used to be thought that if some *later recovery* followed after transplantation, the balance would again be upset, but this has not been the writer's experience in cases observed over many years. Indeed, as the transplanted muscle is never equal to the one it replaces and the latter never recovers 100 per cent. in bad

cases when some recovery supplements the transplant, the result may become almost perfect. The constant support provided by a good transplant tends to induce some degree of recovery in muscles previously thought hopeless.

3. The *tension* of the transplant is the all-important factor in the ultimate result. If the living muscle is sutured over-stretched, it will itself become paralysed ; if it is sutured slack, it will only pull part way. The angle at which the involved joint is placed in the theatre, *e.g.*, half or full dorsiflexion, is the angle to which the transplant can be expected to pull in future. This implies that after-care is maintained in the form of splinting until the patient has obtained voluntary control of the new function. No enthusiastic masseuse must be allowed to break down adhesions and " mobilise the joint," but the patient must actively increase his own range till the transplant is free in both directions.

4. *Suture-material.* In the first Great War, Sir Harold Stiles introduced the wide use of the best *linen thread* for nerve and tendon suture and the writer has continued with it ever since. It induces a minimum of scar formation and is so strong that active use of the tendon (as apart from stretching) can be begun 24 hours after operation, which reduces adhesion formation. There are conditions under which any foreign body will ultimately be extruded from the body and the commonest of these is when the material lies immediately under thin skin. This happens with the transplant of toe extensors described above and the writer has occasionally had one or more of the interrupted stitches work out long after primary healing of the skin wound had occurred. Cultures of such extruded pieces have proved sterile and the tendons have remained united and active.

Attempts to make an artificial *tendon-sheath* are unnecessary, as Nature makes a good one provided the tendon bed is fatty. Foreign materials for a sheath are apt to produce the very scarring and adhesions one means to avoid.

Two transplants not widely known but valuable to the patient are that for clawing of the great toe due to intrinsic muscle weakness and that for loss of opposition of the thumb, due to a similar cause, both very disabling conditions.

Sir Harold Stiles designed an operation in the hand to replace paralysed *lumbricals* by fixing the Flexor Sublimis into the extensor tendon, so that it might flex the knuckle and extend the interphalangeal joints, thus reducing " clawing " and strengthening the grip. The writer applied the same principle to the *great toe* with very satisfactory results for many years. The long flexor is detached from its insertion to the end phalanx and brought up the inner side of the foot and united to the Extensor Longus Hallucis, which nearly always requires a lengthening in such cases. The result depends on the elimination first of any bone deformity or shortening of joint capsules.

Whitchurch Howell many years ago demonstrated an operation for restoring the function of the thumb in thenar paralysis by dividing the Flexor Longus Pollicis at the wrist, pulling the tendon free at the end joint, so that it can be threaded subcutaneously round the back of the thumb and re-joining it again at the wrist. This ingenious method enables the thumb to oppose most of the other fingers, while not losing its function of strong abduction, a power which is lost in the graft operation already referred to. Where the intrinsics are completely gone, the writer has found it useful to combine the transplant with arthrodesis of the carpo-metacarpal joint. Sometimes the end joint also needs fusion, for the flexor even in its new course may over-flex that joint when the extending action of the thenar muscle is quite lost.

After-splinting is important, *e.g.*, by perspex roll or Goldthwait's leather strap. As already remarked, transplants to the shoulder, elbow and hip regions have seemed to the writer seldom likely to give the stability required at those levels.

(*b*) JOINT-FUSIONS.

The technique of the triple tarsal arthrodesis as popularised by Dunn in this country and Hoke in U.S.A. are fairly well known, but a few points may be referred to :—

1. *Incision*: the one commonly used is behind the external malleolus, but the writer has found much better access by a curved one beginning *in front* of the Peronei and passing down the fibula, and then outward to the base of the 5th metatarsal.

2. Removal of bone should be the minimum possible, but it is important to displace the foot well back on the leg bones and so reduce leverage on the dropped front part and also to relax the tendo Achillis, which is often a little short in drop-foot cases, but not enough as to warrant lengthening of the tendon. If the patient is only four or five years old, and it is quite useful to operate at those ages in picked cases, then the articular cartilage can be removed with a heavy knife, like peeling an apple; but none of the other cartilages should be taken as it is the source of future bone growth. If the operation is done in this manner, the deflection of growth forces into normal directions from faulty ones will *stimulate growth* not inhibit it, though one cannot guarantee that the foot will completely catch up to the normal one.

The operation is best done with a *tourniquet*, which should not be removed until the plaster-splint has set. It is important to include the knee in slight flexion, otherwise pulling on the calf muscles disturbs the tissues and causes very persistent pain. For 24 hours, in any case, heavy doses of hypnotics are indicated, as one has disturbed every joint in the foot with many nerve endings. The limb should be kept slung in a cage for two weeks as circulation is always poor in the kind of foot which needs the operation.

The writer finds it convenient to remove stitches in two weeks, having applied a posterior slab-plaster only, fixed by wet muslin which unites with it and allows ready access to the wound. If there is any blistering, which is a fairly common complication on the thin, tense skin over the external malleolus, then this can be dried up with spirit dressing or by leaving it exposed to sunlight under a windolite cage. At the end of three weeks callus will have united all the bones with a sort of soft glue, which prevents displacement but allows very accurate moulding, on which the final condition of the limb depends. Therefore this is the time to apply a close fitting walking plaster, well moulded under the arch but keeping the os calcis slightly everted on the astragalus, for a stiff foot is most manageable in slight valgus and unlike the movable foot, it will not tend to lapse further into valgus. There is no object in retaining a case in hospital once such a plaster is on but it is wise to protect it with a Böhler iron, not to take weight off the bones, but to keep the plaster clear of mud, for children who are to spend six months in such a plaster become very active in it and it is difficult to restrain them even from football. For adults a period of three months usually suffices. If one removes the plaster in three months in a case with very decalcified bones, the arch will gradually sink, or if some strong muscles remain on one side, they will twist the soft bones into varus or valgus. When the operation is carried out in very small children, then it is wise to protect the foot for very many months in a moulded leather support within the boot and this can be used instead of plaster at the end of three months, which enables leg massage to be given. Perspex is being experimented with as a substitute for the leather owing to its lightness, but is neither easy nor cheap to fit accurately.

For cases of severe Calcaneus with complete calf paralysis, the writer has found it useful to modify the Dunn method, *i.e.*, to carry out the tarsal arthrodesis in two stages and to supplement it by active transplant of the Peronei and Tibialis Posticus to the calf, provided they remain intact. If one raws the cartilage from the midtarsal joints in the first stage, one can correct all the cavus, which masks the calcaneus and get firm fixation by strapping the foot with the toes nearly on the shin. At the second stage when the foot is movable as one mass, one can take the wedge from the back of the os calcis with the patient prone and judge accurately the degree of tip-toeing required. This should be considerable as some gets lost in the course of years. With the posterior incision at the second stage, one has ready access to the active muscles and paralysed tendo Achillis and can unite them under correct tension. As a further safeguard the writer has carried out a procedure advocated by Elmslie, *i.e.*, to split the wide tendo Achillis and use one half as a passive sling by wrapping it round the fibula subperiosteally and sewing it to itself. By the time this sling might be giving way, the active transplant should be working well. These cases tend to have a very stunted foot and so it is useful to put them in the leather mould, which fills up a slack ordinary boot and

thus enables them to use a pair and avoid the expense of repeated "surgical boots."

Shoulder arthrodesis also deserves a word of comment. Here again there is no object in postponing operation in the hope that the bones will join better when the patient is older. The converse is true, but to keep the best angle in the joint it must be supported for many months, or the abduction will reduce itself gradually.

The usual technique is to approach the joint from above and the difficulty in securing firm union is due to the smallness of the area of bone on the scapula which can be rawed, even if the acromium is bent and scraped as well as the glenoid. The capsule in paralysis cases is even more lax than normal and the leverage of the arm tends to separate the bones. Therefore a shoulder-spica must be applied to include the pelvis. The writer has found it useful to pad this well round the limb, leaving the upper surface thin and the under one specially reinforced. After some weeks one frees the wrist only. The muscle contractions of the whole limb associated with hand movements stimulate bone formation. A few weeks later the elbow can be released, to upward movements only, and one gets some idea whether the shoulder feels stable to the patient. Finally the whole upper arm is freed and, if the patient can be felt to move humerus with scapula, the entire plaster is removed. If one applies a removable splint a few weeks after operation, it may be broken or removed by a careless patient and a sudden strain applied which breaks the thin callus of the joint. If when union feels solid the X-ray shows much decalcification, the limb can be comfortably supported for part of each day by attaching a wrist-strap to a webbing cap made like those worn by footballers.

Recently the writer has tried a new technique designed to give more raw bone and less need for prolonged support in abduction. The joint is opened from *below* and *behind* with the patient prone, and the capsule opened between the infra-spinatus and the teres major. With a gouge the whole glenoid surface and a piece of neck are turned upward as a flap within the capsule; then the humeral head is partly dislocated downward and a flap similarly cut from it, but from above down, so that the two bone flaps approximate their raw surfaces within the capsule, which they fill tightly. The tense capsule acts as a splint and the only outside support needed is a plaster loop from clavicle to forearm, such as is used for fractured clavicle. With this method soft union occurred in three weeks in an adult and firm union in six weeks, after which only an ordinary sling was used, while at the end of three months the limb had full function unsupported. This shortening of splint fixation is a great advantage for adults. In children treated by the old method plaster may be required for a whole year to ensure permanent bony union.

Spine graft technique cannot be described in detail here. The writer finds the most rapid fusion obtained by combining part of the Hibb's

technique with the addition of a long tibial graft cut from the spongy front wall of that bone and not from the rigid crest. Such a graft will spring a little to fit mild curves.

If one merely raws laminæ and spinous processes, turning flaps down tile-fashion from them in the Hibb's method, one obtains a very vascular bed and if one packs with sponges the size of a finger-tip (also Hibb's idea) which must be counted, there is very little loss of blood. The complete Hibb's technique with opening of all the posterior joints each side gave much shock, and the polio cases which require grafting are all poor subjects for long anæsthesia with poor air entry to the lungs. By this combined technique the writer was able to graft 12 ins. of the spine in a delicate girl, who has survived fit many years. Although one cannot usually cut a single graft more than 8 ins. long from the tibia of such a case, yet if one splits the graft by two saw cuts before one lifts it out, these can be placed with an overlap of one or more inches, so that the doubled part comes opposite the area of greatest weakness, *i.e.*, an overlap like tiles.

Finally, as to the area of spine to be fixed. This is very important. Long ago Galeazzi of Milan pointed out that if one controlled the vertebra intermediate between the two main curves one so reduced the leverage that progressive increase of the curves ceased. In applying this principle to grafting, one makes the graft cross from the concavity of the curve below to that above by placing it on the centre of the spine of this critical vertebræ and one bridges as much as possible of the most mobile of the two curves, usually the lumbar one, for in life they both increase together. If the patient is treated for some time on a short posterior plaster-bed of Waldenstrom's type, with the prone position by day, the spine will be found to soften a little and improve, particularly in its kyphos before solid ankylosis occurs. The writer has found by X-ray comparison that the curves are locked from further relapse for periods up to ten years. No case has been done much longer than this for results to be recorded.

Finally a word may be said on the technique of checking the growth at the lower epiphysis of the femur. This is done much as in the McEwen osteotomy, but the bone must be divided much lower than the adductor tubercle and it is most convenient to approach it first from the inner and then the outer side, so as to cut the bone clean without displacing the epiphysis by any manipulation. To make sure of early bone formation, it is useful to put a small sliding graft each side, cut vertically from the cortex. Careful and prolonged after-splinting is essential, for in the United States numerous cases have been recorded of late deformity attributed to displacement of the epiphysis on the shaft during convalescence.

The writer likes to operate on the Jones' frame, which ensures control of the hip, for assistants are scarce and apt to tire. At the end of the operation a plaster-slab is applied from the groin to the toes with the

knee straight. At the end of five or six weeks the limb is gently lifted out for X-ray examination, but is not left free until bony union is unmistakable. Very little discomfort is suffered by the patient if this procedure is followed.

Finally to sum up the principles which should guide us in operating for polio-myelitis :

(*a*) One should aim at forestalling deformity, and never need to correct it.

(*b*) One should study the function of the limb and indeed of the body as a whole which implies a thorough vetting of the patient stripped before operation and the use of judicious splinting for as long as necessary afterwards. There is no make haste quickly at any stage in the treatment of polio.

(*c*) In children one should give due consideration to the effects of growth, which does not mean that operation must always be postponed *for years, often the reverse. Tissues which are deflected back to normal* lines will tend to develop normally both in direction and size: those in whom] the forces make for mal-aline, will produce even more severe deformity and therefore require more severe operations.

(*d*) With modern anæsthesia, properly given, very frail subjects will stand quite severe operative procedures. .

(*e*) With children and the modern hospital-school facilities time is of little importance. With adults, if an operation can really enable long conservative treatment to be cut out, then the time-saving value is a real one.

But when all these considerations have been weighed, the surgical treatment of polio-myelitis, whether in the acute or chronic stage, is still a matter for long-term planning, a phrase so much the subject of controversy in other spheres.

THE LIBRARY

Recent Acquisitions of Historic Interest

THE HISTORICAL DEPARTMENT of the College Library has received a number of valuable and welcome accessions during the last year. These have been exhibited from time to time in the Reading Room with other early books already in the collections. It is a particularly pleasant duty to record the generous donation by Mr. David Eccles, M.P., of two rare anatomy books given in memory of his father, the late William McAdam Eccles, F.R.C.S., Consulting Surgeon to St. Bartholomew's Hospital and for long a very loyal son of the College and a regular reader in the Library, who served on the Council 1914-22 and 1924-32. Mr. Eccles' gift consists of two books by Alexander Read, a Scottish physician and anatomist who was active in London at the beginning of the seventeenth century. Read was highly thought of in his own day, but the modern reader of his books notices that his anatomy is completely in the old tradition and remained uninfluenced by Harvey's teaching ten years after the publication of the discovery of the circulation. None the less his books are important records of the general state of knowledge against which Harvey's revolutionary teaching slowly made its way. Alexander Read and his friend Helkiah Crooke were among the first to provide English anatomists with textbooks in English instead of Latin. Following the example of Continental anatomists they planned to provide a large illustrated human anatomy book to be accompanied by small handy manuals for the use of students attending their anatomy lectures. The large book was completed by Crooke, and the College has long possessed copies of his *Microcosmographia, a description of the body of man* published in 1615, with a second edition in 1631. Read compiled several small handbooks of which the best known is his *Somatographia anthropine or a description of the body of man* 1634. This is really a series of small plates with brief explanatory text, based on Crooke's large book and ultimately deriving from Vesalius. It was published " by Michael Sparke at the blew Bible in Greene Arbor " and with it was issued Crooke's book on *Three and fifty instruments of chirurgery*. Mr. Eccles has now presented two much rarer works—Read's *Treatise of muscules* (muscles) and his *Manuall of dissection*. The Eccles copy of *The Manuall of the anatomy or dissection of the body of man* 1638 comes from the library of King Charles I, to whom the book was dedicated by Read. It is in a contemporary gold-tooled binding with the royal arms on back and front and the initials C.R. (Carolus Rex) written inside the front cover. *A treatise of all the muscules of the whole bodie* 1637 contains the lectures which Read

delivered before the College's predecessor, the Barber-Surgeon's Company of London.

The Council has lately bought a beautiful copy in contemporary vellum binding of Laurent Joubert's book on the treatment of gunshot wounds —*Traicté des arcbusades*, the first edition printed at Paris by P. l'Huillier in 1570. Joubert was professor of medicine at Montpellier; he describes himself on the title-page of his book as "Physician to the King, and his Reader in the School of Medicine at Mompelier." He was one of the most distinguished and versatile medical men of the late sixteenth century, the period of the first important advance of surgery under the impact of the religious wars which followed the Reformation and in which gunshot wounds first began to be widespread. Joubert's treatise is an important landmark in the history of war surgery; he himself had served as an army surgeon. It was followed in England by the *Proved practice concerning wounds made with gunshot*, written by William Clowes, surgeon to St. Bartholomew's, and first published in the Armada year, 1588. These two vernacular books with some slightly earlier Latin treatises on gunshot wounds by Italian surgeons were exhibited in the Library during the summer.

By a fortunate coincidence two other books by Joubert were shortly afterwards presented by Sir Charles Sherrington, O.M., F.R.C.S. They formed part of a group of early medical books presented by Sir Charles as the latest of a long series of such generous gifts which he has made to the College over many years. The two books by Joubert are his "First three books of practical medicine"—*Medicinæ practicæ priores libri tres*—published in 1572, and his edition of the *Grande chirurgie* of Guy de Chauliac, the most famous French surgeon of the late middle ages. This edition of Guy's text which is followed by an equally long book of "annotations" by Joubert himself was published at Tournon by Claude Michel in 1598. It contains two woodcut portraits of Joubert. Included in the Sherrington donation are several works by Jean Fernel, the French renaissance physician whose importance in the history of medicine and physiology had been forgotten and has been brought to remembrance by Sir Charles Sherrington. He first dealt with Fernel in two Vicary Lectures delivered at the College in 1937. The matter of these lectures was expanded in part in Sherrington's important philosophical survey of biological knowledge, *Man on his nature*, Cambridge 1940, where he contrasts Fernel's outlook with that of a modern medical scientist. More lately Sir Charles has published a full-scale study of Fernel and all his works under the title *The endeavour of Jean Fernel*, Cambridge University Press 1946. The books by Fernel which he has now presented to the College are the following:—

Therapeutices universalis seu medendi rationis libri septem (Seven books of general therapeutics) printed at Frankfurt by André Wechel in 1581. Wechel was a well-known Paris printer who migrated to Frankfurt for fear of persecution as a Protestant. With this is included Fernel's

Two books on the hidden causes of things—a philosophical and astrological treatise with whose importance in Fernel's thought Sir Charles has dealt in some detail.

Secondly, Fernel's *Consiliorum medicinalium liber*, Paris 1582. This is a collection of consultations from Fernel's practice as the leading physician of his day.

Thirdly, a posthumous issue edited at Utrecht in 1656 of his *Universa medicina*, a general textbook of medicine.

Sir Charles has also presented a modern French edition, which includes the Latin text and a French translation of Fernel's *De luis veneræ curatione perfectissima liber* (The best treatment of the venereal disease) originally published in 1579.

DIARY FOR OCTOBER (15th-30th)

Wed.	15	5.00	Mr. G. Massie—Neoplasms of the Colon.
		6.15	Dr. E. A. Pask—Resuscitation.
Thur.	16	3.45	Dr. J. Garlock—Surgical Treatment of Carcinoma of the Oesophagus.
		5.00	Prof. E. Finch—The Cancer Problem.
		6.15	Dr. B. R. M. Johnson—Intravenous Anæsthesia.
Fri.	17	5.00	Prof. Murray A. Falconer—Hunterian Lecture—A Study of Principles and Results of Lumbar Intervertebral Disc Surgery.
		6.15	Dr. M. Dawkins—Epidural Analgesia.
Mon.	20	6.15	Dr. R. W. Cope—Anæsthesia for Babies and Children.
Tues.	21	6.15	Dr. V. F. Hall—Post-anæsthetic Treatment.
Wed.	22	5.00	Mr. H. F. Lunn—Arris and Gale Lecture—Contribution to the Anatomy of Inguinal Hernia.
Thur.	23	5.00	Prof. W. E. Gye—Imperial Cancer Research Fund Lecture.
Fri.	24	5.00	Mr. H. F. Lunn—Arnott Demonstration—The Pelvis and the Erect Posture.
Mon.	27	5.00	Mr. H. F. Lunn—Arnott Demonstration—The Applied Anatomy of Testicular Descent.
Tues.	28	5.00	Mr. H. F. Lunn—Arnott Demonstration—The Cerebral Cortex and the Status of Man.
Wed.	29	5.00	Mr. W. R. Douglas—Moynihan Lecture—The Surgical Treatment of Metastatic Carcinoma of the Cervical Glands.
Thur.	30	5.00	Dr. Craigie—Imperial Cancer Research Fund Lecture.

DIARY FOR NOVEMBER

Mon.	3		Final Fellowship Examination (Ophthalmology and Oto-laryngology) begins.
		6.15	Mr. J. A. James—Acute Rhinitis and its Treatment.
Tues.	4	6.15	Dr. F. S. Cooksey—Physical Treatment in Oto-laryngology.
Wed.	5	6.15	Mr. M. L. Formby—Acute Infections of the Pharynx and Parapharyngeal Space.
Thur.	6		Final Fellowship Examination (General Surgery) begins.
		6.15	Dr. H. Davies—X-ray Diagnosis in Oto-laryngology.
Fri.	7	6.15	Mr. J. Crooks—Sinusitis in Childhood.
Mon.	10	6.15	Mr. E. D. D. Davis—Malignant Disease of the Pharynx.
Tues.	11	6.15	Mr. J. McGibbon—Otitis Media in Childhood.
Wed.	12	5.30	Annual Meeting of Fellows and Members.
		7.00	Monthly Dinner for Fellows, Members and Licentiates.
Thur.	13	5.00	Sir Cecil Wakeley—Bradshaw Lecture—Vogue and Fashion in Abdominal Surgery.
Fri.	14	6.15	Mr. W. A. Mill—Neurological Disorders of the Pharynx and Larynx.
Mon.	17	6.15	Mr. T. Cawthorne—Aural Vertigo.
Tues.	18	6.15	Mr. J. C. Hogg—Non-Malignant Strictures of the Oesophagus.
Wed.	19	6.15	Mr. C. P. Wilson—Carcinoma of the Oesophagus.
Fri.	21	5.00	Dr. I. Harvey Flack—Vicary Lecture—Lawson Tait.
		6.15	Mr. J. Pennybacker—Brain Abscess in Relation to Diseases of the Ear, Nose and Throat.
Mon.	24	3.45	Mr. S. Mottershead—The Blood Supply of the Hindgut.
		5.00	Prof. R. J. McDowall—Shock.
Tues.	25	3.45	Dr. J. Whillis—The Anatomy of the Oesophagus.
		5.00	Dr. F. C. Courtice—Oxygen and Carbon Dioxide Transport.
Wed.	26	3.45	Mr. R. J. Last—The Segmental Innervation of Limb Musculature.
		5.00	Prof. A. C. Frazer—Fat Metabolism.
Thur.	27	3.45	Prof. J. Kirk—The Fœtal Circulation.
		5.00	Dr. D. J. Bell—Carbohydrate Metabolism.
Fri.	28	3.45	Dr. P. R. Peacock—Experimental Study of Breast Cancer.
		5.00	Dr. L. E. Glynn—Hepatic Dysfunction.

TWELFTH CONGRESS OF THE INTERNATIONAL SOCIETY OF SURGERY

THE CONGRESS was opened at the Great Hall of Lincoln's Inn on Monday, 15th September, 1947. Sir Alfred Webb-Johnson, President of the Royal College of Surgeons of England welcomed the delegates :—

SIR ALFRED WEBB-JOHNSON : " I very deeply appreciate the privilege of presiding at this Inauguration of the first post-war Congress of the International Society of Surgery. And, first, I bring you a message from The King. It comes in reply to greetings which I sent to His Majesty on your behalf.

September 15th, 1947.

The British members of the International Society of Surgery with their humble duty beg to offer their loyal and devoted greetings to Your Majesty; and all the members assembled at the Inaugural Meeting of the XIIth Congress, representing over 40 countries, beg to offer their best wishes and to express their most grateful thanks for Your Majesty's interest and gracious Patronage. It will be their earnest endeavour, by the exchange of views and experiences, to contribute to the advancement of the science and art of surgery for the relief of human suffering which Your Majesty has always had so much at heart.

Alfred Webb-Johnson, President, Royal College of Surgeons.

Balmoral Castle.

I should be glad if you would express to all assembled at the twelfth Congress of the International Society of Surgery my sincere thanks for their kind message which I much appreciate. I send my best wishes for the success of your meeting and trust that your deliberations may further the all-important work which you have in hand. GEORGE R.

15th September, 1947.

And now I offer you all a warm welcome to London and to the Royal College of Surgeons. I hope that the Delegates of various countries and all the members of the Society will have a happy and a profitable week. The importance of this Congress for the advancement of surgery is obvious, but meetings like this have a further value. By virtue of our calling we are all patriots of humanity and, as such, know no frontiers. But by virtue of our citizenship we are also ambassadors of our own countries and, as such, can help to promote peace, concord and understanding between nations.

You know, gentlemen, that our welcome is warm, so I make no apology for any austerity in our entertainment. Our present difficulties, we are told, are financial—but we know that they are the result of proudly shouldering a moral obligation to humanity and—If blood and tears and toil and sweat be the price of honouring that debt, Lord God, we have paid in full.

Whatever our College has to offer is at your disposal, and your President, as an Honorary Fellow, has the keys of entry. We ask you all to use it at your need and pleasure. Vous avez les clefs de notre Collège, Monsieur le Président, mais, pour vous et pour tous vos collègues la porte est toujours ouverte.

Time was when we could have held this Meeting in our College and,

thanks largely to the sympathy, encouragement and generous help of surgeons from all parts of the world, that time will come again. But, meantime, as some of our amenities have been destroyed we are especially grateful to the Treasurer and the Masters of the Bench of the Honourable Society of Lincoln's Inn for putting this beautiful Hall at our disposal. It is a worthy stage for this important assembly, and it is a singularly appropriate one, for surgeons have much in common with the Law, and my College has much in common with Lincoln's Inn.

But the picture behind me represents "The Origin of Legislation," and serves to remind us that, although Law and Medicine are closely allied, there is one great difference between us. *We* have no Legislative Chamber to enact laws for us. We are our own lawgivers ; or, rather, we must discover the laws on which our profession rests ; we must discover them and not invent them, for the laws of Nature are not to be invented. —And now you must proceed with your voyage of discovery.

Chèrs collègues des pays étrangers—au nom des chirurgiens Anglais, Écossais et Irlandais—je vous accueille très très chaleureusement. Et maintenant, le prográmme du Congrès est formidable et très exigeant. Il faut que vous vous appliquiez. Ainsi,—Prenez vos places. La partie commence."

Dr. Leopold Mayer, President of the Congress, delivered the Presidential Address.

During the Congress Professor Grey Turner was elected President of the Thirteenth Congress to be held at New Orleans in 1949.

On September 14th, members of the Congress from over 40 countries were welcomed by the President, Vice-Presidents and members of the Council of the Royal College of Surgeons of England at an informal reception held at the College.

Three distinguished members of the Society were admitted as Honorary Fellows of the College. The ceremony took place in the Lecture Hall and was opened by an Address of welcome by the President, Sir Alfred Webb-Johnson.

Professor Grey Turner introduced Dr. Mayer as "one who has devoted his life to the development of the ideals of international friendships for the benefit of surgery, and whose efforts in this direction go back to the formation of the International Society." Professor Grey Turner went on to recall that Dr. Mayer had attended every meeting of the Congress, and that on one occasion, in 1938, he attended on a stretcher.

The President, taking Dr. Mayer by the hand, said, "Dr. Mayer, in the name of the College, and by the authority of the Council I admit you to the Honorary Fellowship of the Royal College of Surgeons of England."

Dr. Mayer expressed his gratitude for the honour conferred upon him, and said he had received with great pleasure the first two numbers of the Annals.

Sir Cecil Wakeley introduced Professor Victor Veau and Sir Gordon Gordon-Taylor introduced Professor Robert Danis ; these Surgeons were then admitted by the President as Honorary Fellows of the College.

ADMISSION OF HONORARY FELLOWS

PRESENTATION OF THE LISTER MEDAL AND THE HONORARY MEDAL OF THE COLLEGE

PRESENTATION OF DESK AND LECTERN BY THE AMERICAN COLLEGE OF SURGEONS

on

Monday, 22nd September, 1947

SIR ALFRED WEBB-JOHNSON : " Ladies and Gentlemen, we are meeting here to-day to welcome and do honour to a number of very distinguished surgeons from across the Atlantic. We hail them not only as representatives of the American College of Surgeons but because of their distinguished labours and great achievements. Their records remind us of the rich gifts that have come from the laboratories and clinics of Canada and the United States. Our colleagues have been full of generosity —in their pioneer work, their gifts to humanity and also as teachers, and we might say, like Claudio, ' What have we to give you back, whose worth would counterpoise your rich and precious gifts ? ' Our recompense is thanks, and this might be all did we not hold in trust some treasured tokens and exclusive emblems of merit which it is our duty and privilege to award when proper occasion arises. I ask you, Mr. Vice-Presidents, to conduct to the dais those who have been selected by the Council for the highest honours which our College has to bestow."

SIR HENEAGE OGILVIE : " Mr. President, I have the honour to present to you Dr. Arthur Wilburn Allen, President of the American College of Surgeons, to receive from you the Fellowship of our College. He is a Bachelor of Arts, Doctor of Science (*Honoris causa*) of Georgetown College, Kentucky, Doctor of Medicine of Johns Hopkins University, Chief of the East Surgical Services, Massachusetts General Hospital, and lecturer in surgery at Harvard University, which, I understand, holds a comparable position to our University of Oxford. For many years he has been on the Board of Regents of the College which he now leads. He is a member and officer of every distinguished surgical society in America, has been given Academic honours and has made contributions of lasting importance to gastric surgery. Above all, as a clinical teacher he has few equals and certainly no superiors. In conclusion, I feel that this description of Arthur Wilburn Allen gives a poor picture of one who stands in the high regard and affection of the surgeons of all nations. He is one of three or four people whose name given in baptism has been replaced by that of ' Jimmy ' Allen by all those who love him in his University. He is a great friend to all who visit Boston and a life-long friend of this College. May I present Arthur Wilburn Allen."

THE PRESIDENT: " In the name of the College and by the authority of the Council I admit you as an Honorary Fellow of the Royal College of Surgeons of England."

DR. ALLEN: " Mr. President, Friend Heneage, I greatly appreciate these high tributes which are being paid to me. When I received the official communication from your Secretary informing me that the Council had deemed me worthy of this high honour there came over me a warm glow of pleasure, one of deep satisfaction. On further consideration, however, it seemed to me that other things came into my mind, a feeling of humility and unworthiness, and I realized that in honouring me you were honouring the American College of Surgeons which I represent. This American College of Surgeons may very well not have existed had not it had before it the marvellous inspiration of the Royal College of Surgeons of England. These two organizations, stand, I believe, for the same principles, the same high ideals, the one unit of effort to improve surgery for the benefit of mankind throughout the world. I express my very deep appreciation and my very sincere thanks for this high honour."

MR. L. E. C. NORBURY: " Mr. President, it is my honour to present to you Dr. Irvin Abell, immediate past President of the American College of Surgeons, to receive at your hands the Honorary Fellowship of this College. Dr. Abell needs no introduction to this College, he is honoured and well known in its precincts. Dr. Abell was born in Kentucky and had a medical education at Louisville, there graduating at the University. Now Kentucky, I think you will probably know, is famous not only for its eminent surgeons, but also for other things. It is famous, I think, Sir, for its blue grass and its magnificent breed of horses and also for its enormous production of tobacco, and last but not least for its magnificent brand of alcohol. So there are famous things that come out of Louisville. Now Dr. Abell, as you know, is Chairman of the Board of Regents. That is a most responsible and august body and to be chairman is a really great honour. Dr. Abell has held that Chairmanship for some time. That body is closely identified with this College and we have a great bond of sympathy. There are all sorts of things I could say and a few I must say. He is a Doctor of Science of several Universities in the United States and also a Doctor of Law and he had a very creditable war record and did a lot for the advancement of science and traumatic surgery. He has written quite a considerable amount, a large number of contributions to literature, and I have had the pleasure of seeing some of them. I notice he lays great stress on hospital organization and standardization which I think is a most important thing. There is another thing about his contributions. At the Assembly of Initiates in 1946, when he was President, he gave a Lecture to the Initiates and took for his text the Fellowship of the American College of Surgeons, and the most important thing he stressed there was the importance of pooling scientific

knowledge. One other thing I must say, and that is that his hobby is a fondness for travel. We are delighted to hear that, because that attribute has brought him to London and also guided his footsteps to the precincts of Lincoln's Inn Fields. From what I have said, it will be acknowledged that he is a man of outstanding merit and surgical ability and a worthy recipient of the honour he is about to receive."

THE PRESIDENT: "In the name of the College and by the authority of the Council, I admit you as an Honorary Fellow of the Royal College of Surgeons of England."

DR. ABELL: "Mr. President, I am profoundly grateful for the honour you do me. The Royal College of Surgeons for 160 years has contributed to the science of medicine, and by its acquisition and dissemination has improved the standards and the art and science of surgery and really established it as a benefactor to mankind. I say it is unique, meaning that in the strict sense of the term, because there is no other organization with which to compare it. With all humility, I take my place in your ranks and trust and pray that I shall be worthy of the confidence you have reposed in me."

SIR CECIL WAKELEY: "Mr. President, I present to you Doctor Frank Howard Lahey, Founder and Director of a famous surgical clinic in Boston. We in England have known of his writings since 1909 and his activities and his writings are far too numerous for me to recite. Suffice it to say that his colleagues in America elected him President of the American Medical Association in 1941, and he was consulting surgeon to the United States Navy in the second World War, serving most of the time in the Pacific theatre. He is a man of action, a practical surgeon with that great ability of choosing the young surgeon who is going to become the master surgeon in the future. But Dr. Lahey has not allowed work to monopolize all his time. He knows how to relax. He is fond of shooting, fishing, and loves dogs, especially Pointers, and his colleagues and his students did him the great honour of presenting him with a birthday volume on his sixtieth birthday. What greater signal honour could any surgeon wish to have than this. I have great pleasure in presenting Dr. Frank Howard Lahey for Honorary Fellowship of our College."

THE PRESIDENT: "In the name of the College and by the authority of the Council I admit you as an Honorary Fellow of the Royal College of Surgeons of England."

DOCTOR LAHEY: "Sir Alfred, Sir Cecil, Fellows of the Royal College of Surgeons, in a career the length of which I am becoming all too aware of, and the breadth of which you have judged most generously, nothing has come to me which has given me greater pleasure or of which I will be more proud than this Honorary Fellowship of the Royal College of

Surgeons. As I thank you for it, I am sure that you will not be disturbed by the fact that, in my thanks to you, I record also gratitude for my associates and assistants who, by their loyal and generous action, have in a considerable measure made this honour possible for me. I would feel unworthy of it were it not for my opportunity to mention this. You have sent to America many of your young men, during the war, and since. We have been delighted to welcome them and we hope you will continue to send them in constantly increasing numbers and when happier times come to you as we all feel sure they will, we hope that more and more of our young men will come to you to exchange ideas and to establish firm friendships. It is perhaps a little Hibernian-like to express this sentiment, but between these two nations occasionally occur some superficial irritations, but I am sure that in the depths of their hearts run very common sentiments and extremely common standards of morality that are so badly needed in the world to-day."

Sir Hugh Cairns: " Mr. President, I present to you Doctor D. B. Phemister. Dr. Phemister has made outstanding contributions to the pathology of surgical shock and lesions of the bones and the joints. His work on aseptic necrosis of bone is a classic in its comprehensiveness and in its use of the experimental clinico-pathological approach. Some twenty years ago, Dr. Phemister gave up a successful career as a practising surgeon to found a whole-time department of surgery at the University of Chicago and it is a matter of satisfaction to us that in preparation for this mission he worked for a greater part of a year in the department of physiology in University College. His work is outstanding and also the work of his associates. In his department in recent years, the work on prostatic cancer opened a door for the chemo-therapy of cancer. The work of other associates and pupils of Dr. Phemister has been no less distinguished, if less dramatic. That a department should house a group of such unusually able surgeons is no coincidence. Nor is it a coincidence that the investigations have been consistent with the expert use of the experimental approach. This has been brought about by his deep interest and austere renunciation of all else but the pursuit of truth. Here is a surgeon who stands out in his generation as a successful exponent of the ideals of John Hunter whose work stimulates our American colleagues no less than us of this College and gives us vitality and inspiration. I present to you Dr. Dallas Phemister."

The President: " In the name of the College and by the authority of the Council I admit you as an Honorary Fellow of the Royal College of Surgeons of England."

Dr. Phemister: " I can most quickly and efficiently express my thanks by concurring in the very delightful remarks which my American colleagues who preceded me have made, and I thank you most profoundly

for the honour of Honorary Fellowship in the Royal College of Surgeons."

PROFESSOR LAMBERT ROGERS: "Mr. President, I present Professor Alfred Blalock, Professor of Surgery of the Johns Hopkins University, a Member of the Board of Regents of the American College of Surgeons and a master of vascular surgery, whose efforts in this field have prolonged many young lives and offered very much hope for the future of this branch of surgery. He is a worthy successor to William Stewart Halsted, an Honorary Fellow of this College, whose Chair he now so adequately and appropriately fills. Finally he is one whose research into the nature and treatment of shock contributed considerably to the Allied war effort. I have pleasure in presenting Dr. Alfred Blalock."

THE PRESIDENT: "In the name of the College and by the authority of the Council I admit you as an Honorary Fellow of the Royal College of Surgeons of England."

DR. BLALOCK: "It would be impossible for me to express my thanks for this honour which, in my case is truly a great surprise. I am particularly pleased that I should have been presented by Professor Rogers and if Mrs. Blalock is here, I am sure she concurs in my feelings. We became very attached to him and to Sir Gordon Gordon-Taylor when they visited us during the war. Thank you very much."

SIR MAX PAGE: "Mr. President, I have great pleasure in presenting to you Professor William Edward Gallie, of Toronto to receive at your hands the Honorary Medal of the College. I may remind the Council and Fellows that the Honorary Medal of this College was established in 1802. It was first given in 1822 and it has only been awarded on 20 subsequent occasions. Among the names of the recipients are to be found those of Richard Owen, Erasmus Wilson, James Paget, and Joseph Lister. Professor Gallie requires no introduction to this College. He is a friend of many years of most of you. He is a Fellow of 30 years' standing. Many learned and surgical societies have honoured him on account of his scientific work and practical studies in regard to the grafting of bone and fascia. His practical application of the latter studies has made his name a household word for surgeons throughout the world. For 20 years or more as Professor of Surgery at Toronto he has put his stamp on the Canadian surgery of our generation. For five years he occupied the post of President of the American College of Surgeons, which is great evidence of his excellent personality. We are delighted that our most distinguished Fellow should be honoured by the presentation of this Medal."

THE PRESIDENT: "Professor Gallie, I have the privilege of handing to you our most exclusive emblem of merit which has been awarded to you

in the name of the College and by authority of the Council. This is the Diploma which records the award. Before you leave the platform, I will have another word to say to you."

PROFESSOR GALLIE: "I am so overwhelmed with emotion on this dramatic occasion that I find it quite impossible to express adequately my appreciation of the great honour you do me. I am not so naive as to think you do this solely because of the kind things Sir Max has said of me. You do it not only to honour me but to honour the American College of Surgeons and the surgeons of my own country. This Royal College of Surgeons has given me the most thrilling moments of my surgical career. I came here nearly 40 years ago to win my Fellowship and then 15 years later as Hunterian Professor and now you have seen fit to confer on me this very great honour. That you should think that, as a son of this ancient College, I have upheld its traditions in my far country gives me the greatest satisfaction and fills me with pleasure.

THE PRESIDENT: "I have something to communicate and I would like to communicate it in public. This cable reads: *Please convey to Professor W. E. Gallie when Gold Medal of College is conferred upon him congratulations from Toronto and Canada.*"

MR. H. S. SOUTTAR: "Mr. President, I have the distinguished honour to present to you Dr. Evarts Ambrose Graham, 28 years Professor of Surgery in Washington, a past President of the American College of Surgeons and the American Surgical Association. Dr. Graham's place in surgery depends on the magnificent advances he made in the science and the art of surgery. His name is a household word in connection with the progress of the surgery of the gall-bladder. Yet he has always remained a general surgeon, with these great advances to his credit. He won all our hearts a few years ago as temporary Professor of Surgery at St. Bartholomew's, and then we saw his skill, not only as a mere surgeon, but as a man and a teacher. Our College has marked its appreciation of his grand services by joining with others in awarding him the rare award of the Lister Medal and I present him to you that you may hand him that award."

THE PRESIDENT: "This Medal has been waiting for you for some years but there have been difficulties in reaching these shores and apart from those difficulties we have all had other important duties. We have however kept the Medal safely and we are looking forward to Thursday when you will deliver the Lister Oration. I present you with this rare and treasured emblem not only in the name of my College, but in the name of the Royal Society, the University of Edinburgh, the University of Glasgow, and the Royal College of Surgeons in Ireland, whose President (Mr. Frederick Gill), is here to-day to honour the occasion.

I think I would like the President of the Irish College to come to the platform and take part in the presentation. I have very great pleasure in presenting to you, Dr. Evarts Graham, the Lister Medal."

Dr. Evarts Graham: " Mr. Presidents, Mr. Souttar, Fellows of the Royal College of Surgeons of England and Guests, I have been thinking about this Medal for so long as you indicated, Mr. President, that it has caused me much worry to know what I should say when this great occasion should arise and I would be standing on this platform receiving the Medal from you. In all sincerity, I do feel the greatest of humility in having been selected as the recipient of this award. Because of that humility and because I was afraid my emotions might run away a little, I thought it would be safer if I jotted down my remarks on paper. I am sure that to have one's name added to the list of distinguished predecessors who have received this Medal is one of the greatest honours that can come to any surgeon. At the same time the fact that this Medal commemorates and bears the name of Lister, the greatest of surgeons, one who made modern surgery possible, must by comparison make the recipient realize how puny he is and how inconsequential his work has been. It is an inspiration to have been in these hallowed rooms in which once walked Lister, Hunter, and the rest of the galaxy who laid the everlasting foundations of surgery. We Americans have always admired the dominant character of the British. Phoenix-like, your President has told us of new plans to build a new College in these ruins and we appreciate those plans. Nothing typifies the determination of all you British to carry on than a little personal anecdote which I hope I shall be pardoned for telling. In the spring of 1942, about a year after the terrible night of May 10th, 1941, in which this College or a large part of it was destroyed, I received a letter from him bringing me the news that I had been awarded the Lister Medal. He asked me to come over in September to give the Oration. No mention was made of the fact that the most terrible war in history was going on full blast. In my reply thanking him, I was compelled to state that I was under the impression that a war was going on and for that reason it would be impossible for me to take the trip to London. He wrote back admitting reluctantly that perhaps it might be better to wait until the war was over. Of such firm stuff is the British nation composed, and I like to think that perhaps we have inherited a modicum of that firm stuff from you, the Mother Country. Thank you Mr. President."

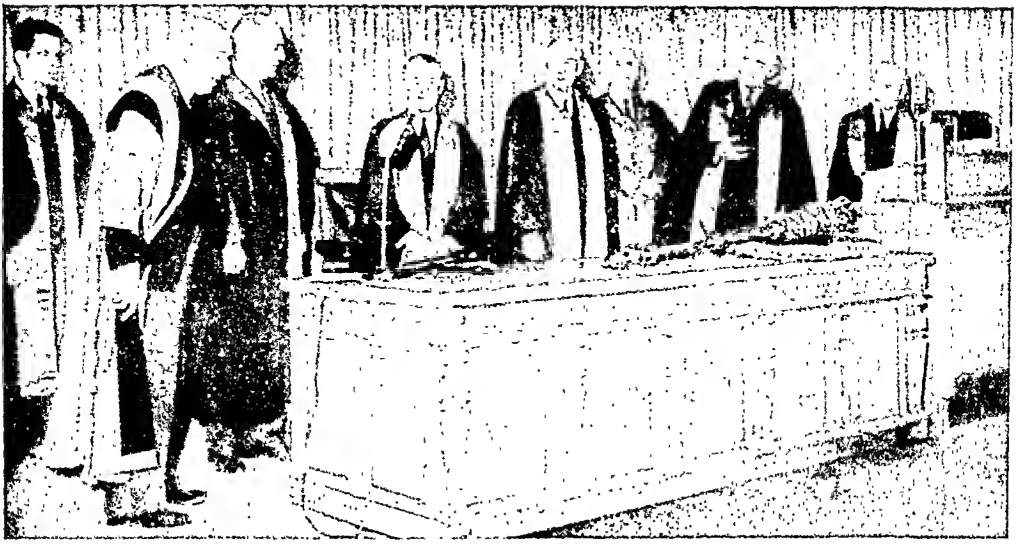
The President: " I will now give place to the President of the American College of Surgeons."

Dr. Allen: " Mr. President, Ladies and Gentlemen, we are now about to consummate an idea which was conceived several years ago, executed well before the war, but, due to conditions beyond our control, has not taken place until this memorable occasion. In this very distinguished

group of men who represent the American College of Surgeons: we have three past Presidents, a President Elect, a Member of the Board of Regents, and a Member of the Board of Governors and the Judiciary Committee. Any one of these could have done this service well, but it is my very good fortune to be able to have them with me this afternoon. I am going to ask only one of them to speak to you and that is Dr. Abell, a long time Chairman of the Board of Regents who will give you some facts concerning this lecture table and lectern it is our pleasure to present."

DR. ABELL: " Mr. President, Fellows of the Royal College of Surgeons of England, Ladies and Guests. The American College of Surgeons has long awaited the opportunity to express through its accredited representatives a personal appreciation of the friendly links which bind the two Colleges. The Royal College of Surgeons has been a perennial source of inspiration to the modelling of the American College of Surgeons. At its inaugural convocation in 1913, the then President of the Royal College of Surgeons, Sir Rickman Godlee, a nephew of Lord Lister, brought its friendly greetings and hearty good wishes inscribed on illuminated parchment which to-day reposes in our treasured archives. During the intervening years many of your distinguished Fellows have graced our annual convocations, bringing to us and sharing with us their rich knowledge and ripe experience. For many of these the golden key of death has opened the palace of eternity, and their names and fame have become your heritage and our legend. I will not intrude upon your time in mentioning all of these but beg your indulgence in mentioning some whose contributions made an indelible imprint on our memory. In October, 1917, the Fellowship Address was delivered by the then Sir Berkeley Moynihan, his subject being ' What is the war about? ' The United States had declared war in March, 1917, but the medical profession of our country was slow in realizing its implications. The stirring Address of Sir Berkeley, in which I remember his graphic description of the battle of Ypres, focussed the attention of our Fellows on their responsibilities and brought into the Medical Corps of the Army those whose surgical knowledge and experience qualified them for service. In 1920 at Montreal Sir Berkeley delivered the Murphy Oration and exhibited a comprehensive knowledge of the character, the attainments and the contributions of this master surgeon. With his colleagues Sir William Taylor and Mr. Albert Carless, he brought to the American College of Surgeons the Great Mace as a present from the consulting surgeons of the British Armies. His presentation address was a most gracious one and concluded with the following lines :—

' We pray that you may regard it as a symbol of our union in the harsh days of trial: as a pledge of our devotion to the same imperishable ideals: as a witness of the unchanging and unfaltering hope that the members of our profession in the two lands shall be joined forever in brotherhood in the service of mankind.'



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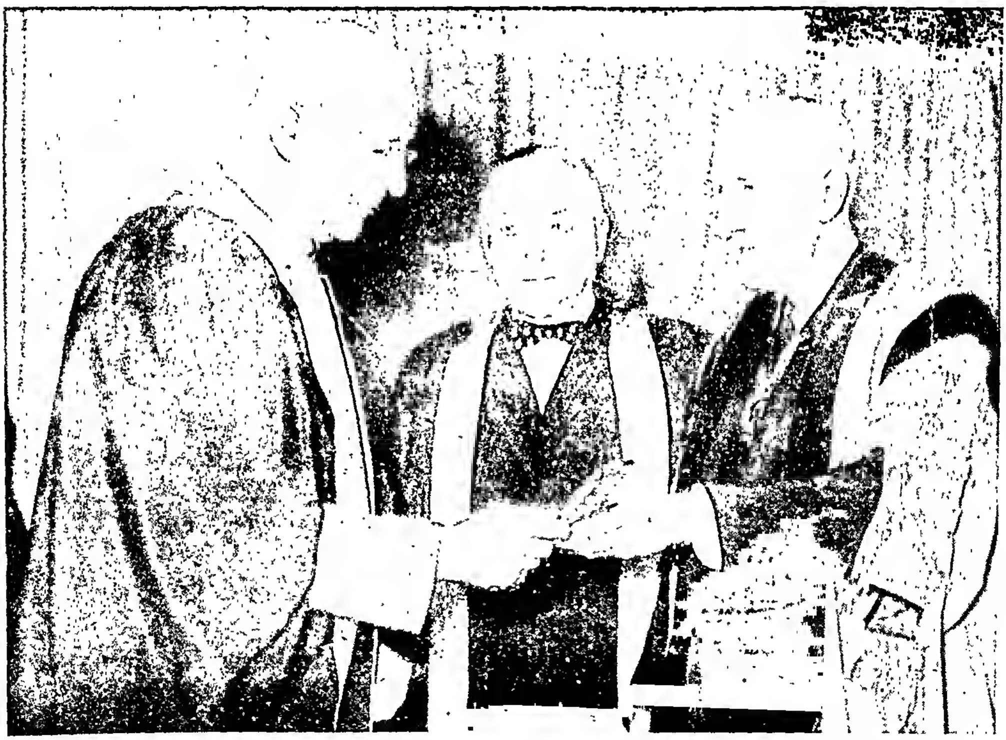
PRESENTATION OF DESK AND LECTERN BY THE AMERICAN COLLEGE OF SURGEONS

Left to right: Dr. A. Blalock, Sir Alfred Webb-Johnson, Bt., P.R.C.S., Dr. Dallas Phemister, Dr. Frank Lahey, Dr. Irvin Abell, Dr. Evarts Graham, Dr. W. E. Gallie and Dr. Arthur W. Allen, President of the American College of Surgeons.

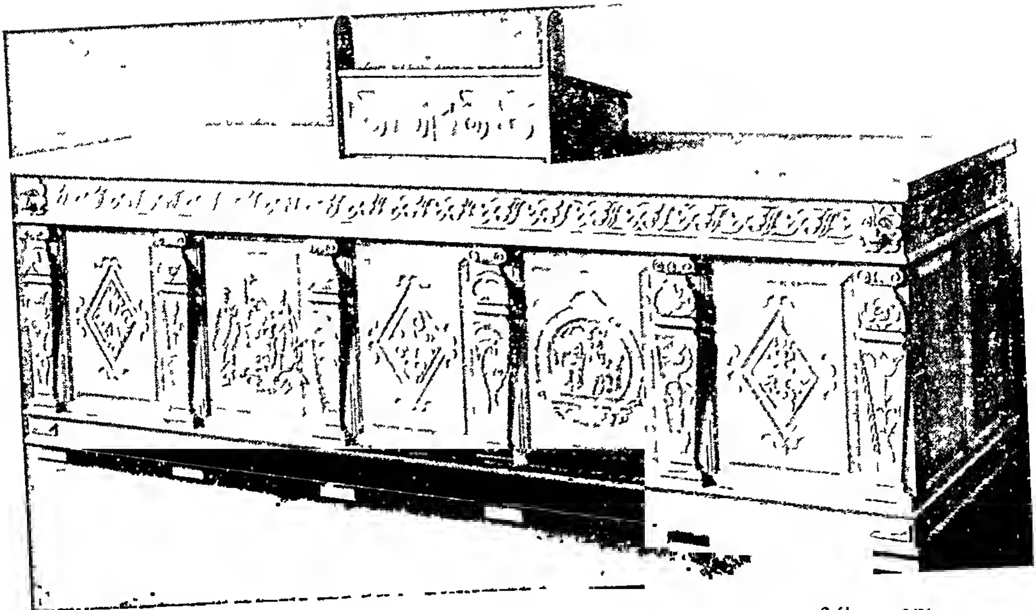


By kind permission of *The Times*

PRESENTATION BY THE PRESIDENT OF THE LISTER MEDAL TO DR. EVARTS GRAHAM

(The President of the Royal College of Surgeons in Ireland, Mr. Frederick Gill, can be seen in the centre of the picture.)

[*Facing page 232*



The Desk and Lectern presented by the American College of Surgeons to the Royal College of Surgeons of England.

The Lister Medal.

The Honorary Medal of the Royal College of Surgeons of England.

It is a source of great gratification to us, Mr. President, that the hope so eloquently expressed by Sir Berkeley more than a quarter of a century ago has seen its fulfilment with its roots so deeply embedded as to give assurance that it will endure through the years to come. Among the others who made the long trip to America to deliver the Fellowship Addresses and Orations and whose masterly contributions are gratefully remembered are Sir Alfred Webb-Johnson, Sir Anthony Bowlby, Professor George Grey Turner, Sir William de Courcy Wheeler, Sir William Arbuthnot Lane, Mr. Arthur Burgess, Sir James Walton, Mr. John P. Lockhart Mummery, Sir John Bland-Sutton, Sir Charles Ballance, Sir Heneage Ogilvie and Sir Gordon Gordon-Taylor. The happy relations existing between the two Colleges and our appreciation of your help, your advice and your participation in our meetings led to a unanimous desire on the part of the Board of Regents of the American College of Surgeons to present to the Royal College of Surgeons a token of mutual friendship. While discussions of the project continued through several years in our Board, as to which would be proper and as to what might prove acceptable to you, the idea did not reach fruition until 1939. The rest of the story, Mr. President, I leave in the more able hands of my colleague."

Dr. Allen: " Mr. President, by and with the authority vested in me by the Fellows of the American College of Surgeons, I herewith present to the Royal College of Surgeons of England this lecture table and this lectern as a token of our great appreciation of past favours to our College, of our high esteem and our undying friendship."

The President: " It is my privilege in the name of this College, to endeavour to express our feelings of gratitude. Of course, I have got used to the idea of this gift. I heard of it nearly a quarter of a century ago when I was in Chicago to deliver an Address to a Clinical Congress of your College. I was there in 1923 and I thoroughly enjoyed it. I thought you were a nation of hustlers, and here is a quarter of a century gone by. I suppose you were waiting until I was in the position of President so that I might be the one to receive it. Anyway, I can add a little item to the history put before you, and that is that this beautifully finished lectern, with its symbolic decorations and its legend recording the source of the gift; and its perfect fitness is due to the loving care of the present President of the American College of Surgeons and to his wife, Mrs. Allen, who has given considerable attention to the details. When you come to open the drawers and cupboards you will realize that a woman has been watching over the finishings. I would like to tell you also that, as you know, you left in our hands the final finish of colour and polish, and the final details of arrangement, and I would like you to know that the British workmen, old in their craft, were lost in admiration for the beauty of the timber which had been selected for the gift and the exquisite craftmanship that had been

put into its making. This gift, Sir, will be a constant reminder to those of us in this College of our common aims and ideals. It will be a constant reminder of your extraordinary generosity at the time of our disaster. It will be an inspiration to us in our work in the future and will help to cement for all time the constant friendship between our Colleges and our countries. It will also be a reminder to young graduates in this country who aspire to high places in surgery of the debt they owe to the great teachers of surgery in America. It means much to us, it will mean more to our successors. It is a visible token of our friendship and common purpose. It will be part of our history. It will be inscribed in our history and becomes of our traditions. It will therefore be preserved, for traditions that are not valued, that are not guarded and that are not expounded afresh to each generation as it in its turn steps into the arena of the centuries, those traditions will pass. This tradition will be expounded afresh to each generation, and each will learn how we stood together as brothers on this platform to-day. I hope you will take from all Fellows and Members of the College and all the important bodies associated with it our affectionate and cordial greetings to the American College of Surgeons. It has just occurred to me that possibly there is another explanation for the reason of nigh on a quarter of a century's delay before this desk and lectern were put into use. Maybe our colleagues of the American College were waiting until their President could be the first Lecturer to use it, and that he will do at a reasonable interval after five o'clock, in a lecture to which we eagerly look forward."

DUODENAL ULCER

A comparative survey of the immediate and interim results on two groups of patients: one treated by subtotal gastrectomy, and the other by vagus resection.

Moynihan Lecture delivered at

The Royal College of Surgeons of England

on

22nd September, 1947

by

Arthur W. Allen, M.D., F.R.C.S. (Hon.)

President of the American College of Surgeons

THERE ARE FEW specific diseases of the human body that have precipitated the volume of scientific interest devoted to duodenal ulcer. Progress has been made concerning the pathologic process and the physiologic requirements of the lesion. Interesting concepts have been advanced regarding the neurogenic imbalance existing in ulcer patients. It would be amiss to state that treatment of this malady has made no progress. The fact remains, however, that there is still much to be settled concerning rational therapy. Statements to the effect that duodenal ulcer is increasing due to our mode of life with its uncertainties and vicissitudes are offset by our improved diagnostic methods.

There seems to be a general agreement that duodenal ulcer cannot occur without hydrochloric acid. This is often, if not always, associated with hypersecretion. Why do nine individuals of the same social status, the same heredity, and environment with all the common problems of life fail to develop ulcer while the tenth person becomes so affected? What brings about this derangement of physiology? Answers to these questions are voluminous and include everything from posture to psychoneurosis. It is not my purpose to enter into a discussion of these matters but to bring before you the results of certain methods of treatment.

It is generally conceded that a large majority of patients with duodenal ulcer can be taught to live with their affliction in a manner compatible with comfort and a useful life. In some clinics with the combined efforts of the internist and psychiatrist, a suitable conservative regimen can be worked out for approximately 90 per cent. of these people. At times, these measures are regarded by the patient as too rigid for his temperament and he may, of his own volition, choose the consequences of neglect or shop about for more radical treatment. It is not uncommon to have such a patient vociferously berate our medical colleagues for withholding a completely successful surgical respite. Little does he realize the difficulties through which surgery has passed in the effort to solve this problem since the first immediately brilliant results of gastro-enterostomy were introduced by Lord Moynihan, in memory of whom this lectureship was established. The operative mortality rate has been

reduced to a very low figure but still must be seriously considered. The complications following surgery for duodenal ulcer may, on occasion, outweigh any protection or benefit to the patient. A comparatively simple problem may be turned into a very complex situation. For these reasons, it is unlikely that surgery will invade the field of treatment of duodenal ulcer in a much higher percentage of cases than exists to-day.

It has been generally accepted that certain victims of this malady are best treated by surgical methods. The *acute perforation* must be closed as a life-saving procedure. *Cictricial obstruction*, the result of repeated flares or continued activity, must be dealt with as a mechanical problem. *Massive hæmorrhage*, which has a tendency to recur in spite of good conservative management, is often best treated by radical measures. There is a fourth group of patients, who try as best they can with the best advice obtainable, who find life intolerable. Either due to their temperament, their social status, their family responsibilities or their mentality, they are unable to keep their ulcer under control and retain their independence as an economic unit of society. They literally cannot support their ulcer and themselves. These individuals have loosely been thrown into the category of *Intractability*. It does appear that with caution, the surgeon may accept some such patients. However, it has been my experience that most of the failures of surgical treatment have come from this ill-defined group. Surgery has one more place in the programme and that is to improve or correct the complications that have resulted from previous operations. The most serious of these is *anastomotic ulcer* so common after gastro-enterostomy and occurring too often after so-called radical subtotal resections.

The present concept of surgical relief of duodenal ulcer is based on the principle of permanent lowering of acid levels in the stomach. This actually means a reduction of the stomach secretions as a whole. Such a state may be accomplished in several ways. One is the elimination by surgery of that portion of the stomach which contains the acid-activating substances known to exist in the antral segment.[1 2 3 & 4] In order to be certain that antral cells are not left behind, a subtotal resection amounting to not less than the distal half and often the distal three-fourths has been generally accepted. It is certain that the antral mucosa extends high on the lesser curvature and oftentimes farther along the greater curve of the stomach than the anatomist's conception of the normal. An ideal resection should include the lesser curve in its entirety, sufficient greater curve for easy mechanical manipulation, and the first portion of the duodenum. Modifications of this procedure will be illustrated later which, in theory as well as in practice, seem to accomplish the desired result. Effort has been directed to a reverse of this procedure by Connell,[5] who has advocated the resection of a large portion of the fundus of the stomach, thus eliminating sufficient acid-secreting cells to accomplish the same purpose. This attack has met with less favour than the other approach. A third method is the interruption of the para sympathetic

nerve supply to the stomach. It has long been known that the vagus nerves control the amount of stomach secretion and thus the acid level. Attempts have been made to denervate the stomach by numerous surgeons in the past—most of these have not succeeded because of the inadequacy of their procedures. Somervell[6] has attempted to reduce stomach secretions by a subtotal interruption of the blood supply.

At present, there are two operative procedures that have appealed to the majority of surgeons as being most logical in the management of this problem. Since we have had direct access to the study and observation of these two methods in a reasonable number of cases, it is pertinent that we compare the immediate and interim results in the two groups. The limitations and advantages of one method over the other in dealing with certain problems will be discussed. Inasmuch as some of the unfavourable sequelæ appear for many years after an interim of good health, the term end-result will not be used.

Subtotal Gastrectomy

This term has been generally adopted to refer to a partial resection of the stomach in the attempt to remove the acid-activating area of that organ. It has been interpreted by some to mean a more generous removal of the stomach than is deemed necessary by others. Failures are often attributed to an inadequate resection and, in fact, in many instances higher resections in such cases have on occasion brought relief. There is evidence to show that close proximity to the duodenojejunal junction in the anastomosis may result in fewer anastomotic ulcers.[7] The trend to the antecolic hook-up, which is easier technically, has been considered by some as one of the chief reasons for failure. These points are difficult to prove clinically and only the careful analysis of large groups of cases will finally settle this controversy. It is our opinion that the short posterior anastomosis is more physiologic and therefore may prove to give a higher percentage of good results. That all of the antrum must be sacrificed is now well established.[4] The highest incidence of failure is in that group of cases treated by gastrectomy for exclusion with a portion of the antrum left in situ.

In 196 patients subjected to subtotal gastrectomy for primary duodenal ulcer by me, I have found that the ideal procedure seemed justifiable in 138 (Group I). Twenty more have been treated in the same manner with the exception that the duodenum has been transected proximal to the ulcer (Group II). Thirty-five others have had the mucosa of the antral segment carefully removed in order to obtain a satisfactory closure (Group III), while in three cases a deliberate two-stage procedure has been carried out. Subtotal gastrectomy with closure of the antral segment is done as a first stage. Excision of the antral segment six weeks later is accomplished as a second stage (Group IV). It is believed that by using these four methods we may select the one for each individual patient best suited to his general condition and his pathologic process. We feel

justified in our conclusion that by any of these methods the primary concepts of subtotal gastrectomy can be accomplished. The deviation from the "ideal" operation, when the ulcer crater is deep and in the region of the bile ducts, may make the difference between an immediate failure and a good result. When the inflammatory reaction is such as to make the dissection of the region hazardous, the operation used in Group III has been satisfactory. Since the chief source of mortality now is in the lack of tight closure of the duodenal stump, it seems likely that these alterations in the standard procedure may influence the outcome in a considerable number of patients. The two-stage manœuvre is championed by McKittrick[8], *et al*, and has worked well in a group of patients so treated by him and the resident staff of the Massachusetts General Hospital. The induration in and about the ulcer subsides considerably during the six weeks' interval between stages so that the final resection of the antral stump is carried out with much greater ease than it could have been accomplished at the primary procedure. Although it has the same disadvantages of any two-stage operation with its so-called double risk, it has much to commend it. This operation is particularly adaptable to the surgeon in his formative period and to those whose experience in this field is limited.

We have eliminated from this survey operations for duodenal ulcer that were done after one or more unsuccessful procedures, usually carried out elsewhere. We have, for sake of comparison with vagus resection, taken into consideration only those patients who have been subjected to subtotal gastric resection for duodenal ulcer as a primary operation. We have excluded patients with massive hæmorrhage in the acute phase, some of whom were operated on as a last resort. We believe, if such cases are selected for surgery within 72 hours of the onset of hæmorrhage, that most of them will survive. If, on the other hand, one accepts such a case after seven days from the beginning of the episode, few will recover. We still believe as formerly that younger patients[9] will almost invariably recover from a bout of hæmorrhage to be evaluated for surgery later, while the patients beyond the age of 45 should be subjected to radical surgery as early as the diagnosis can be made and shock controlled.

The results obtained in this group of patients are summarised in Table 1. All patients operated on who fail to leave the hospital alive, regardless of the cause of death, are considered operative fatalities. It is of interest that the mortality rate has decreased with time and only one death occurred in the last consecutive 113 cases. This fatality was due to coronary occlusion 48 hours after operation. It is obvious that the trend of operative mortality in all surgical procedures is downward.[10] There are many contributory factors involved in this improved status. Better understanding of the physiologic needs of the patients with a correction of these prior to surgery, better anæsthetic methods, improvements in surgical technique, adequate blood replacement, more logical wounds and their closure, and proper after-care are the chief reasons for

lowered mortality. The use of antibiotics and chemotherapeutic agents must be given proper credit, although it is best to consider these aids entirely as an adjunct in order to stress that they, in no way, permit any diminution of the best surgical principles known. Although the trial and error methods that develop experience in any field of surgery have contributed to the improvement in results in the past, it is believed that modern teaching of surgery by the resident system will greatly reduce fatalities previously apparent during the formative years of the surgeon.

Table I

DUODENAL ULCER—PRIMARY RESECTIONS* **

	Type of Operation				
	I	II	III	IV	Total
Cases	138	20	35	3	196
Deaths ..	3	1	0	0	4

* Excludes resections for previous unsuccessful surgery and those for acute massive hæmorrhage.

** One death from coronary occlusion in last 113 cases.

Although the immediate mortality may have been reduced to the minimum, there are other unsatisfactory sequelæ that must be considered. *Anastomotic ulcer* may be the most serious of these because it usually requires further surgery for correction. There have been many contributions to the subject of this complication, all of them based on concepts believed by the surgeon to be important. That a remnant of antral mucosa left in situ is the commonest cause of stomal ulceration seems agreed upon by everyone. This is best illustrated by the fact that in an otherwise satisfactory subtotal resection, the jejunal ulcer will heal after excision of the remaining segment of antrum. In other cases, the fault may lie in the inadequate removal of the lesser curvature. It is interesting to note that in the hospital pathologic specimens, when the lesser curve measurements were over 11 cms., anastomotic ulcer was rare; while those of less than 10 cms. in length were more often associated with this complication. The distance from the duodenojejunal junction to which the stomach segment has been anastomosed is stressed by workers in Wangensteen's clinic. They have shown that anastomotic ulcers will develop in dogs in a direct ratio from 0 in the most proximal jejunum to 100 per cent. in the terminal ileum.[7] They are sure that antecolic anastomosis will result in a higher percentage of stomal ulcer than will be found following the retrocolic hook-up. In spite of a short loop posterior anastomosis in nearly all of our cases and an effort to always do an adequate resection, we have experienced anastomotic ulcer in six patients. In a previous report,[11] we have brought out that one-third of all jejunal ulcers occur in the first year and another third in the second year after the original gastro-enterostomy, while the remaining third is scattered over an 18-year period. This leads us to assume that a certain number of our patients, who are now symptom free, will in the future develop this complication.

Other sequelæ that are disabling are related to a "small stomach" and those associated with rapid emptying, termed the "dumping syndrome." Persistent gastro-intestinal symptoms of some degree occurred in about one-third of our cases. Most of these are trivial in nature and can be brought to light only by specific interrogation. These minor complaints are those of certain food idiosyncrasies such as intolerance to fats, carbohydrates, milk, cheese, chocolate, &c. Weight loss or inability to gain weight may be disabling and occurs as a chief source of complaint in a small number of patients. Some patients never seem to be able to eat a full meal at one time and some of them complain of postprandial nausea and loss of appetite. Others, with symptoms referable to rapid emptying, have weakness and vertigo, rapid pulse, sweating of the forehead, diarrhœa, and abdominal pain after eating. These are often transitory and have a tendency to clear up. Most of these patients are thus affected following breakfast only.

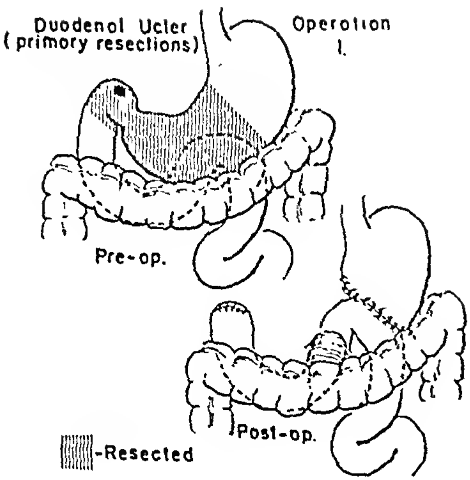
In spite of these poor or unsatisfactory results, approximately 85 per cent. of our patients consider that they have a satisfactory result. Most of them are enthusiastic in evaluating their present state of health and often say that they are free from discomfort for the first time in many years; are able to eat and drink anything they choose and carry on their usual occupation with normal pleasure.

It appears that the individual, who has never been interested in food and has always been a finicky eater, is more likely to have unpleasant sequelæ than is the gourmet. It must also be remembered that a considerable portion of the population, who do not have duodenal ulcer, have chronic gastro-intestinal complaints.[12]

It is interesting that in our group of cases, a greater percentage of the men get satisfactory results than do the women. More of the females have symptoms referable to either rapid emptying or a small stomach. Since it is well known that anastomotic ulcer is less common in women than in men, we believe that a less radical resection may be justifiable in the fair sex.

Vagus Resection

The terminology applied to this procedure has not been completely standardized. Vagotomy, vagus section, vagectomy, vagus resection and gastric neurectomy have been used. It is well known that the autonomic nervous system has a most determined tendency to regenerate itself after interruption.[13] If then we expect permanent effect on ulcer of the duodenum or jejunum, we should resect sufficient nerve pathways to make regeneration less likely if not impossible. Vagotomy and vagus section imply a simple division of the nerve trunks, and vagectomy a complete removal of the vagus nerves. Gastric neurectomy should take into account all nerve impulses to the stomach. Vagus resection may also be a poor term but to us has meant the exposure of the vagi from the lung roots to the stomach, excising the distal two to four inches with the



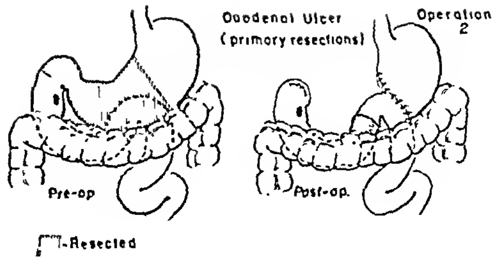
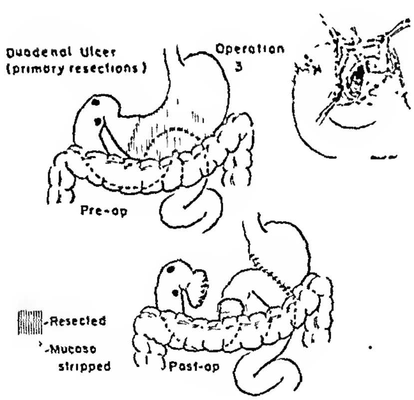


Fig. 1.

Operation I for duodenal ulcer. The resected specimen shown by heavy vertical lines includes the lower two-thirds of the stomach and the duodenal ulcer. Continuity is restored by means of a posterior Hoffmeister anastomosis.

Fig. 2.

Operation II for duodenal ulcer. The resected specimen does not include the ulcer which is located in the second portion of the duodenum. Normal duodenum is closed proximal to the ulcer, *thus excluding the ulcer.*



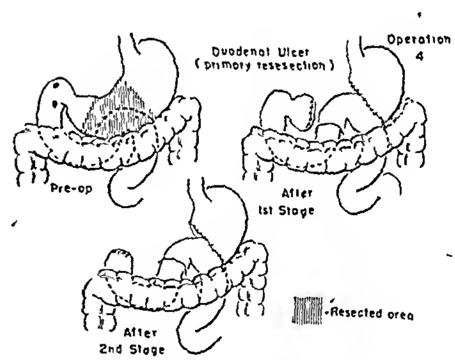


Fig. 3.

Operation III for duodenal ulcer. Inflammatory adhesions about the ulcer make it impossible to mobilize the duodenum. The stomach is transected proximal to the pylorus and the mucous membrane removed. The pyloric muscle is then closed.

Fig. 4.

Operation IV for duodenal ulcer. The stomach is transected proximal to the pylorus. The mucous membrane is not removed, and the pylorus closed. Six weeks later, at the second stage, the pylorus and ulcer bearing portion of the duodenum are resected.

Figs. 1, 2, 3 and 4 reproduced by courtesy of Annals of Surgery, J. B. Lippincott & Co., Philadephia, Pa.

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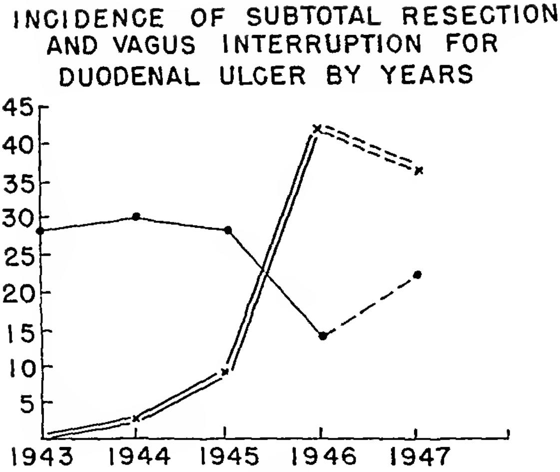

Fig. 5.

Graft depicting the influence of transthoracic vagus resection for duodenal ulcer on the author's personal patients subjected to subtotal gastrectomy for this lesion. The overall picture for the hospital does not reveal the influence of vagus resection over subtotal gastrectomy quite so graphically.

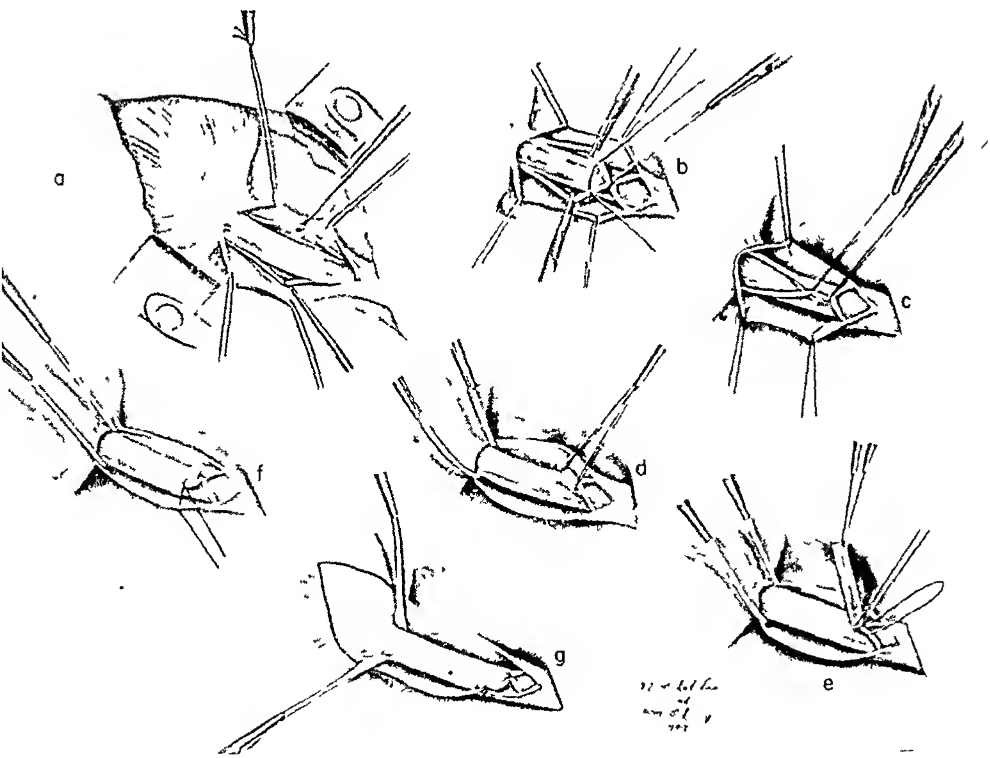

Fig. 6.

Diagrammatic sketch of the transthoracic approach to vagus resection as defined by Dr. F. D. Moore and practised in the Massachusetts General Hospital, Boston, Massachusetts.

additional precaution of incorporating the proximal trunks within an impermeable silk eylinder.

More than 40 years ago, Pavlov[14] sectioned the vagus nerves in dogs and observed that these animals lost their normal gastrie seeretion response to sham feedings, &c. This important observation did not make as much impression on the ulcer problem as one would expeet. This was largely lost sight of following Edkins'[1] experimental work about 1906 and the extensive use of gastro-enterostomy that followed. Stahnke[15] in 1924 was able to produce duodenal in dogs by eleetrieal stimulation of the vagus nerves. Hartzell[16] in 1929 found that section of the vagi redueed the aeid level in the stomaeh seeretion of dogs. He further pointed out that adequate vagus interruption eould only be done transthoracically. These animals had regained their pre-operative acid levels when they were re-studied three years later. Cushing[17] made the observation that there was a tendeney for patients with certain brain lesions to develop duodenal uleer. That there was a definite central nervous system factor, with the ehief pathways between the brain and the stomach being the vagus nerves, seemed established by these observers. Others who have contributed to the study of this problem are Beaver and Mann,[18] Latarjet,[19] and MeCrea.[20] Many unsueeessful attempts have been made to apply this knowledge to the elinieal problem.

Dragstedt[21] and his eo-workers deserve the credit for bringing about a logieal approaeh to the subject and have earried out vagus nerve interruption in a large number of patients with peptic uleer. Their observations are being published with regularity and they have established definite criteria that seem to be important to the problem as a whole. The immediate results are excellent. The patient awakens from anæsthesia free of uleer pain and rapid healing of the uleeration ean be observed by roentgen examinations. A reduetion to normal of the amount of stomaeh secretion with eoineidental lowering of acidity and the laek of response to insulin is an indication that eomplete interruption of the vagus pathways has been accomplished.

Grimson[22] and co-workers have carried out vagus interruption on a number of patients for ulcer and have contributed some important observations relative to the subject.

Bradley *et al*,[23] Miller and Davis[24], and Chamberlin and Winship[25] have reported the anatomical variations found in the course and distribution of the vagi. A certain pereentage fail to follow the pattern of two main trunks with little or no ramification from the lung roots to the diaphragm. These exceptions occur often enough to warrant a thorough search in order to prevent leaving intact pathways that may carry normal impulses and thus result in a continued increased secretion and aeidity. Walter's[26] group feel that they can best avoid this error by a transabdominal approach. They also stress the importance of this exposure sinee it gives a direct view of the pathologic process for which the operation is being undertaken. Furthermore, they believe that in certain

conditions, such as stenosis, a concomitant gastro-enterostomy is logical. They have, on occasion, excised the lesion in gastric or stomal ulcers as an additional safeguard to vagus resection. Miller and Davis,[24] and Chamberlin and Winship[25] have deducted from their anatomic dissections that the transthoracic approach affords a better opportunity to interrupt all pathways regardless of the variation.

At the Massachusetts General Hospital, F. D. Moore[27] has made significant contributions to this problem. Associated with him especially have been C. M. Jones and W. P. Chapman of the medical service, and M. D. Schulz of the radiological department. All of the staff have been interested in the project since its beginning because everyone dealing with ulcer has felt that although subtotal gastrectomy was giving a high percentage of good results, this operation was often not the ideal method of attack. The patients have been carefully selected for the operation. Most of them have been under 50 years of age, have had no obstructive symptoms, and have failed to respond to elaborate conservative regimens. Included in the group are anastomotic ulcers following gastro-enterostomy or subtotal gastrectomy, many of which were performed elsewhere.

Gastric ulcers have not been treated by vagus resection in our clinic because of our inability to determine pre-operatively that the lesion is benign. Studies on our patients for a ten-year period revealed that 14 per cent. of the ulcerations of the stomach, thought to be benign, proved on pathologic examination to be cancer.[28]

Nearly all patients have been studied in regard to their so-called resting gastric secretions and their response to insulin. These determinations are not devoid of error but by comparison post-operatively, one has a good index to the efficacy of the procedure. We are not inclined to believe that a lack of response always means that an inadequate vagus resection has been done. In two patients who failed to get relief of ulcer pain, we are certain that the vagus pathways were interrupted. It leads us to the assumption that a few individuals have other para sympathetic pathways than the vagi between the central nervous system and the stomach, possibly these are cholinergic fibres in the Splauchuic system.

In order to be certain that the vagus nerves are interrupted, we have felt that the transthoracic approach was more logical. This was further supported in our clinic by the extensive experience of Churchill and Sweet[29] in transthoracic operations on the oesophagus and stomach. Their observations on the effects of the removal of the vagi with the oesophagus have been helpful in the technique and have explained some of the after-effects on the remaining gastro-intestinal tract. The abdominal surgeon without thoracic experience can section and remove short segments of these nerves through the abdomen. Those experienced in thoracic procedures however, can, we believe, more satisfactorily carry out complete vagus interruption. Due to Smithwick's and White's[13] influence, we have been fearful of nature's tendency to re-establish continuity when the autonomic nerves are sectioned or an inadequate amount removed. For this reason,

we have incased the proximal ends of the severed nerves in an impermeable silk cylinder as they have recommended. The dissection is carried down to the spread on the stomach so that from two to four inches of the main trunks are removed. Careful search is made for any aberrant trunks or rami and these are eliminated. In many cases, the diaphragm has been opened enough to be certain that the lower ends of the nerves were severed at their decussation on the stomach wall. This is not always necessary since in some cases through the oesophageal hiatus the lower ends of the nerve trunks can be delivered into the chest and severed under direct vision.

Intratracheal gas oxygen and ether is essential for safe and adequate anæsthesia. Either the 8th, 9th, or 10th rib may be resected if one chooses from roentgenograms, whichever one of these is opposite the dome of the diaphragm in the mid-axilla. The mediastinum is entered by severing the inferior pulmonary ligament. After the nerves are resected, the mediastinum is carefully closed by interrupted fine silk sutures. Care is used to aspirate the air from the chest cavity as the lung is expanded. Pre- and post-operative penicillin has been used chiefly in patients with a productive cough.

Although some patients have transient post-operative wound-pain, this is not a major drawback to the transthoracic approach. In order to avoid the early inertia of the stomach musculature, which results in dilatation, an intra-gastric nasal catheter, introduced prior to operation, is left on suction for 48 hours. Bi-daily aspirations may be necessary for a few days afterwards. Moore has observed that these patients seem to have less distention with solid food than with liquids. Later, many patients develop diarrhœa which may be mild and unnoticeable but can be severe and alarming.

From 1944 to August, 1947, 103 patients have been subjected to vagus resection in our clinic. The majority of these operations have been done by F. D. Moore. All have been carried out by the technique he has advocated and all patients have been studied and followed by his criteria. Ninety-eight per cent. of the operations have been done by the transthoracic route of which 42 per cent. complained of minor wound discomfort, while 3 per cent. had major chest or intercostal pain.

Table II

VAGUS RESECTION

8th January 1944 to 8th January, 1947

	No. of Cases	No. of Deaths
Duodenal Ulcer.. ..	75	0
Jejunal Ulcer	22	0
Miscellaneous	6	1
Total . ..	103	1

Seventy-three per cent. have been done for duodenal ulcer. These have been non-obstructing in character. Some of them have had previous

episodes of massive hæmorrhage, most of them have been in the so-called intractable group. One patient had a concomitant small gastric ulcer and another an oesophogeal ulcer as well as duodenal ulcer. Twenty-one per cent. of the patients were suffering from anastomotic ulcers, half of which had followed posterior gastro-enterostomy, the others being subsequent to subtotal gastrectomy.

Eighty-seven per cent. of all these patients had a result that was satisfactory to them. From the standpoint of a critical analysis of the patients by Dr. Moore, the results were classified as good in 75 per cent., fair in 18 per cent., and poor in 7 per cent. In the fair result group, 3 per cent. required posterior gastro-enterostomy later; 3 per cent. had an episode of massive hæmorrhage from the ulcer during early convalescence; 5 per cent. complained of transient ulcer-pain, while 7 per cent. had continued symptoms of fullness or persistent diarrhœa. Of these, the final result was satisfactory to the patient in all save those with continued fullness and diarrhœa.

The poor results from our standpoint are as follows: One patient developed a recurrence of duodenal ulcer without pain or bleeding 18 months after vagus resection. He had at this time cancer of the lung, which was treated by pneumonectomy. Two patients developed ulcer-pain without a demonstrable lesion—these were both psychiatric problems before vagus resection. One developed bleeding and pain without a demonstrable ulcer. Another was unrelieved of a jejunal lesion and found on exploration to have a retained antral segment. This patient was cured by removal of this segment and should probably not be classified as a poor result.

Emptying disorders following the procedure are analysed as follows: 56 per cent. had transient fullness; 31 per cent. had no such trouble; five per cent. had continuing fullness and eructation, while 8 per cent. gave fullness and vomiting as a major complaint. Diarrhœa occurred in 62 per cent. of the patients. It was minor and transient in 48 per cent., major but diminishing in 8 per cent., and major and continuing in 6 per cent.

There were no fatalities in the entire group subjected to vagus resection for ulcer. One death occurred 48 hours following this procedure for the relief of atrophic gastritis with recurrent episodes of massive bleeding and pain. An unsatisfactory anæsthesia may have played the important role. The possibility of hyper-irritability of the autonomic nervous system with reflexes resulting in cardiac standstill must also be taken into consideration. Churchill,[30] in our clinic, called our attention many years ago to the importance of blocking the vagus nerves with novocaine above the point of manipulation in all cases. In addition to this precaution, our patients are given large doses of atrophine before and immediately following the operation.

Excluding the vagus resections done for any other lesions than primary duodenal ulcer for sake of comparison with a similar group treated by subtotal gastrectomy, we may evaluate these two procedures more

clearly. It must be remembered, however, that our follow-up studies on the subtotal gastrectomy patients cover a longer period than do those treated by vagus resection.

Table III gives this information and need not be amplified to any extent.

Table III

PRIMARY DUODENAL ULCER

	Subtotal Gastrectomy	*Vagus Resection*
No. of Cases	196	75
Average Age	47·4 years	42·1 years
Males	84 per cent.	84 per cent.
Recurrent Ulcer ..	3 per cent.	1 per cent.
Good Result	85 per cent.	87 per cent.
Fair Result	7 per cent.	6 per cent.
Poor Result	8 per cent.	7 per cent.
Op. Mortality	2 per cent.	0 per cent.

Under similarly controlled criteria for selection, preparation, age, and sex, anæsthesia, surgical experience, technique, and after care in the same institution, we may be allowed certain deductions. The percentage of satisfactory results is approximately the same in both groups. These are immediate and interim results only. We can be sure that more of the patients with subtotal resections will eventually develop anastomotic ulcer. It is also probable that more of the vagus resection cases will develop cicatricial obstruction requiring gastro-enterostomy, or that late recurrence of ulcer will become a definite problem.

The total unsatisfactory side effects are about the same in both groups of patients. It will require a good many years and very careful follow-up studies to learn the ultimate prognosis in those patients whose immediate result following vagus resection is satisfactory. The advantages of this procedure are a probable lower operative mortality and the non-interference with the normal contour and size of the stomach itself.

Table IV

DUODENAL ULCER—UNFAVOURABLE RESULTS

Subtotal Gastrectomy	*Vagus Resection*
Op. Mortality	Recurrent Ulcer
Anastomotic Ulcer	Persistent Ulcer Pain
Gastritis with Bleeding	Pain and Bleeding
Dumping Syndrome	Fullness
Weight Loss	Diarrhœa
G.I. Complaints	Late Obstruction

Summary and Conclusions

1. Either an adequate subtotal gastrectomy or vagus resection will give a high incidence of immediate relief from intractable duodenal ulcer.

2. Vagus resection is the procedure of choice in anastomotic ulcer following gastro-enterostomy or subtotal gastrectomy.

3. In younger patients with intractable duodenal ulcer without obstructive symptoms, we believe our immediate and interim results are good enough to warrant the continuation of vagus resection as a method of treatment.

4. We do not believe that vagus resection has any place in the treatment of gastric ulcer on account of the difficulty in distinguishing benign from malignant ulceration of the stomach, and the excellent results obtained in subtotal gastrectomy.

5. It is our opinion at this time that the transthoracic approach is the most adaptable to an adequate and permanent interruption of the vagus pathways.

6. Obviously, many years of experience with careful selection of patients and adequate follow-up will be necessary to properly evaluate vagus resection as a method of treatment for duodenal ulcer.

7. At this time, we prefer subtotal gastrectomy for all patients who have cicatricial obstruction from duodenal ulcers, for those with acute massive bleeding when any operation is indicated, and for those with intractability in the older age group.

8. By the proper selection of procedure in subtotal gastrectomy, we believe it is possible to reduce operative morbidity and mortality to a minimum. There are at least four methods of accomplishing this operation satisfactorily.

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SOME ASPECTS OF BRONCHIOGENIC CARCINOMA

Lister Oration delivered at the Royal College of Surgeons of England

by

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Professor of Surgery, Washington University Medical School

on

25th September, 1947

To be awarded the Lister Medal and to be invited to give this lecture before the Royal College of Surgeons of England is without doubt one of the greatest honors that can come to any surgeon. It is a matter of great pride to me to have my name added to the list of those illustrious predecessors who have given this lecture. In the United States we regard with veneration your College of Surgeons with its great traditions and its achievement in setting high its standards of fellowship. We were shocked at the news of the damage to the building by the ruthless bombs of the barbarians, but we who know the British realize well that they can pass through a period of " blood and sweat and tears " undaunted and with heads proudly erect. We expect to see a new and better home for the College built on this site as living evidence of your indomitable and everlasting spirit.

The first comprehensive study of bronchiogenic carcinoma was the monograph of Adler,[1] of New York, published in 1912. Before that time of course much had been written on the subject, but it was all fragmentary. It was Adler who recognized that the importance of the subject deserved a comprehensive study. In the introduction he apologized for writing a book on what was generally considered at that time to be a rare condition. His stated excuse, however, was that he had noted a definite increase in the number of cases reported in recent years. With a streak of clairvoyance he recommended more diagnostic use of the bronchoscope and X-rays, although in 1912 both methods of examination were very crude, and he prophesied that operations would be developed for the removal of the cancer which would greatly change the prognosis. This was a daring prophecy in 1912. By an exhaustive review of the literature of the world he was able to collect only 374 cases of primary carcinoma of the lung.

In contrast the condition is now generally recognized to be at least as frequent as carcinoma of the colon, and Ochsner and DeBakey[2] stated that in 1939 at the Charity Hospital, New Orleans, bronchiogenic carcinoma exceeded in frequency carcinoma of the stomach which hitherto

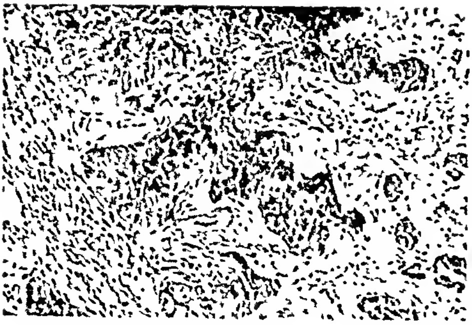

Fig. 1.

Section of tumor, showing squamaus, or epidermoid carcinoma, from first patient to have successful pneumonectomy for bronchiogenic carcinoma. Patient is living and well 14 years and 4 months later.

Fig. 2.

Autopsy case of so-called bronchial adenoma.

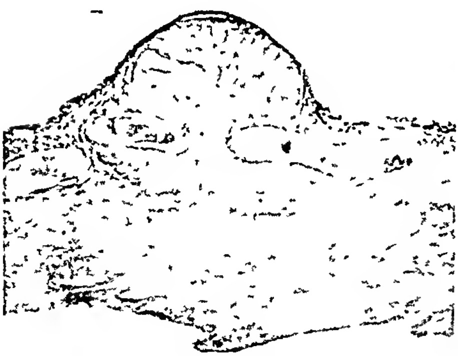

Fig. 3.

Same case showing cross section of tumor slightly magnified. Mucosa is intact over the tumor without ulceration.

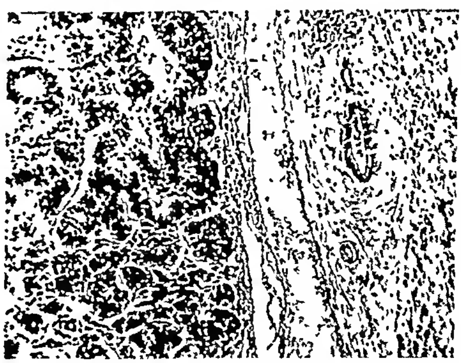

Fig. 4.

Same case with metastasis in the liver. On the left is the tumor and on the right the liver tissue.

Fig. 5.

Another case (H.C.K.). Bronchoscopic biopsy in 1928 showing usual picture of so-called adenoma. History of cough and sputum for 20 years. Galvano-cauterization of movable tumor of size and shape of almond kernel thought to be complete and successful. Death four years later with extensive metastases to liver and lung.

Fig. 6.

Another case (H.R.). Section of lymph gland removed at time of pneumonectomy for so-called adenoma. Close resemblance to picture sometimes seen in tumors of salivary glands. Patient died seven years later with extensive visceral metastases.

Fig. 7.

Another case (H.J.P.). Biopsy of so-called adenoma found at bronchoscopy with typical mucosal layer present and underlying layer of fibrous tissue.

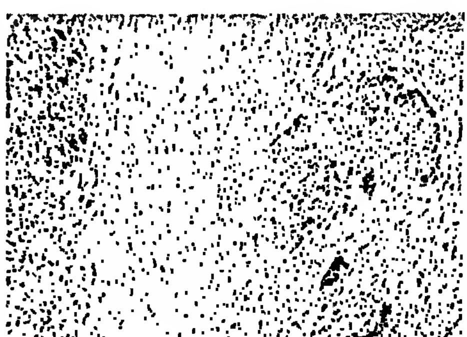

Fig. 8.

(N.V.) Combined carcinoma sarcoma. History of cough many years. Bronchoscopy showed a papillary tumor projecting into bronchus. Pneumonectomy.

has been considered the most common visceral carcinoma. This is of great significance because the Charity Hospital is a large public hospital whose patients represent a rather typical cross section of the population of a large American city. There is no satisfactory explanation of this amazing apparent increase in incidence. Has there been actually an increase in incidence or is it only apparent because of better diagnosis? These are questions to which there is no good answer at present. At any rate, however, the fact is now well established that bronchiogenic carcinoma occurs with sufficient frequency to constitute one of the most important problems in the therapy of cancer.

Until 1933 there was no satisfactory treatment for this condition. Perhaps one is not justified in implying that there is a satisfactory treatment now. Perhaps in the future some non-surgical method will be discovered which will be not only more simple in its execution but more reliable in its results than surgical operation. Yet I think we are now in a position to have a considerable degree of optimism about what can be accomplished for the unfortunate victims of bronchiogenic carcinoma, at least as compared with the possibilities prior to 1933.

In April of that year the writer[3] was fortunate in having an ideal patient present himself with a squamous carcinoma involving the bronchus of the left upper lobe. An unequivocal diagnosis was established by bronchoscopic biopsy. He was a physician, 48 years old. The condition was complicated by the presence of several abscesses in the lobe. It was my intention before operation only to remove the left upper lobe, but at the operation it seemed to me that this procedure would allow some of the cancer to remain. If all of the tumor was to be removed a total pneumonectomy would therefore be necessary, and it seemed to me desirable to perform the operation in one stage. However, before proceeding with the pneumonectomy some features of the problem had to be considered. No successful operation corresponding to a single-stage pneumonectomy in the human had been performed previously. Kümmel[4] in 1910 removed a lung for cancer but the patient died on the sixth post-operative day. In 1919 Lilienthal[5] performed a total pneumonectomy for bronchiectasis but the patient died six hours later. Again in 1920 he performed a pneumonectomy in another case but death occurred 13 days after operation from secondary hæmorrhage. In 1920 also Willy Meyer[6] removed a lung, but the patient died. Nissen's[7] case in 1931 for pulmonary suppuration was of course not a one-stage pneumonectomy. In two stages he passed a ligature around the hilus and the lung later sloughed away. Likewise Haight's[8] case which was performed in 1932 but not published until April 1934 was similar to that of Nissen's in that it was a gradual pneumonectomy for bronchiectasis. In two stages he

ligated the hilus of the left lung and permitted it to slough off. Sauerbruch's[9] case in 1923, a multiple stage procedure, resulted in the gradual sloughing away of the left lung and it is doubtful anyway if the entire lung was removed. Macewen's[10] famous case, sometimes quoted as the first pneumonectomy, was probably only a drainage of a very large cavity. From the report of his operation in 1906 which was performed in 1895 it is clear that he did not remove the entire lung. Archibald's[11] three-stage pneumonectomy in 1932 resulted in death on the fourth day. Windsberg's[12] case, mentioned by Haight as being the first successful pneumonectomy in the United States, was a multiple-stage operation in 1932 for bronchiectasis. Later, however, the patient died and at autopsy it was found that the lower lobe had not been removed. It is to the great credit of Windsberg that he reported this later finding. There were, however, numerous experiences of the successful one-stage removal of a lung in experimental animals. A very excellent review of the literature on these experiments has been made by Crafoord.[13] I shall not duplicate it here.

On the basis of the successful animal experiments I made the decision to undertake the removal of the entire lung realizing that unless that procedure could be carried out the patient would die anyway from his cancer. I was encouraged to make the decision by the fact that I could not detect any involvement of the hilar lymph glands. The patient therefore seemed to be an ideal subject on whom to determine if a cure of a bronchiogenic carcinoma could be obtained by a sufficiently radical operation undertaken before the invasion of the regional lymph glands. Knowing the patient as well as I did I felt even more justified in taking the risk because I was certain that he would rather die of the operation than after a prolonged illness from his cancer.

There was one point, however, which caused me some worry and that was whether or not the sudden blocking of the left pulmonary artery in a middle-aged man with a relatively normal lung might cause fatal consequences of a kind that follow pulmonary embolism. The only other successful case of the removal of a whole lung, albeit in stages, reported up to that time was that of Nissen, a twelve-year-old girl, who had had a severe crushing injury to the chest previously. It seemed possible that in her case, because of the crushing injury, there might have been gradually produced changes in her pulmonary circulation which would minimize the danger of a sudden ligation of the pulmonary artery. It is true that Sauerbruch had practised the ligation of the pulmonary artery in a few cases of severe pulmonary suppuration but here again the conditions were far from normal. Accordingly, I told the anæsthetist that I was going to ligate the pulmonary artery, what my fears were and to observe very carefully the effects on the blood pressure, the colour of the patient, the pulse and the respirations. In order to make the condition easily correctible I passed a small rubber catheter around the pulmonary artery and

tightened it with my hands. Fortunately nothing happened and I proceeded then with the resection of the lung. A mass transfixion ligature of catgut was used for the hilus but the pulmonary artery was ligated separately. After the lung was out the empty pleural space seemed so enormous that seven ribs (the third to the ninth inclusive) were removed in order to accomplish a partial obliteration of it. The immediate postoperative course was uneventful and on the tenth day the patient for three hours attended a meeting of the Clinical Surgical Society which was being held at the Barnes Hospital. Later he developed a small empyema at the upper part of the pleural cavity. The removal of the first and second ribs resulted in the complete obliteration and healing of the cavity.

The examination of the removed lung showed that the carcinoma was only about 1 cm. long and that it was situated almost at the bifurcation of the main bronchus into the bronchus of the upper lobe and that of the lower lobe. The lymph glands removed with the lung and some removed from the mediastinum were free from any involvement with cancer. The prognosis therefore seemed excellent, and the patient's subsequent course has justified that opinion. He is now in his fiftieth year, free from any symptoms, and he carries on an extremely large obstetrical practice in Pittsburgh.

The combination of an early case in a relatively young man in good general condition made the circumstances just right for this first successful one-stage pneumonectomy. I happened to be the fortunate one who encountered them. Any other thoracic surgeon who had met with them would have achieved an equally good result.

Since the publication of that case great interest has been aroused in the whole subject of bronchiogenic carcinoma perhaps because it now seemed possible to apply to a cancer of a lung the same sound surgical principles which had been found effective in the treatment of cancer involving other parts of the body, namely, the removal of the entire organ with the lymph glands most likely to be invaded.

Certain questions about the operative attack on the condition immediately arose. Was it necessary to collapse the empty pleural space by a thoracoplasty? Did similar conditions as to operability apply here as to cancer of other organs? In other words, what were upper age limits, did the presence of pleural fluid contraindicate the operation, was a palliative resection of the lung worth undertaking? Were existing methods of closing the bronchus the best that could be devised? These were some of the problems that presented themselves.

Rienhoff[14] deserves most of the credit for showing that a thoracoplasty is not necessary after a pneumonectomy. Except as a means of obliterating an empyema cavity which has developed as a result of a leaking bronchus, apparently no one to-day employs the procedure.

As experience has developed at the hands of many thoracic surgeons it has been learned that essentially the same principles of operability apply to bronchiogenic carcinoma as to cancer elsewhere except as regards the upper age limit. At least in our experience at the Barnes Hospital we have found that old patients tolerate the operation of pneumonectomy less well than, for example, the operations for carcinoma of the rectum or the breast. The oldest patient successfully operated upon in our series was 68. The operative mortality above the age of 60 is considerably higher than that in the preceding decade. Almost all the deaths in the higher age groups are due to circulatory complications, of which coronary thrombosis or infarct is the chief, which may occur at any time within the first two weeks after operation. The sudden removal of a whole lung with its attendant disturbance of the pulmonary circulation seems to be a physiological blow to an old man of such magnitude that apparently only one with a nearly normal heart can tolerate it.

The presence of pleural fluid, in our opinion, does not necessarily contraindicate a pneumonectomy. The fluid should be examined by aspiration before operation. If it is clear and straw-coloured without the presence of tumor cells exploration to determine resectability of the lung is indicated. Inflammatory lesions are so commonly associated with bronchiogenic carcinoma that it is not rare to find a pleural exudate which is not due specifically to the cancer. On the other hand if bloody fluid, or fluid containing tumor cells, is found it is our opinion that a radical operation is futile. Other findings which preclude attempts to resect the lung are (1) evidences of nerve involvement and (2) recognizable metastases. Nerve involvement is evidenced in several ways. First there is the question of pain. Patients who complain of severe pain have conditions which, in our experience, make a radical resection futile even when it can be done. The pain nearly always means that intercostal nerves or the brachial plexus or both have been invaded by the cancer and that even if the lung is removed some of the tumor will be left behind in the chest wall. Special nerves which, because of the common location of the tumor, are often involved are the phrenic and, on the left side, the recurrent laryngeal where it passes under the arch of the aorta. Invasion of a phrenic nerve is readily determined because of the paralysis of the corresponding half of the diaphragm noted on fluoroscopic examination. Likewise the paralysis of the left vocal cord reveals the involvement of the left recurrent nerve. Rarely, however, it happens, as we have found, that the paralysis of either the diaphragm or the left vocal cord may have been present for a long time due to some other cause. A careful history will be of great help in this connection.

Many methods of suturing the bronchus have been proposed. There is none that is completely satisfactory. Leaks still occur occasionally in spite of the greatest care. Our own preference is two rows of silk sutures, first a row of mattress sutures, then a row of over and over interrupted

silk sutures. Some surgeons prefer to reinforce the suture line with pleura, either a pedicle flap or a free transplant.

The operation of one-stage pneumonectomy is now being performed in all centers where a large amount of chest surgery is done. It has become the standard procedure in the treatment of bronchiogenic carcinoma. It is impossible to know how many of these operations have been performed since 1933. At the Barnes Hospital we have performed 229 one-stage total pneumonectomies, of which 161 have been for tumors of various kinds. The operative mortality, by which is meant deaths before the patients have been discharged from the hospital, has shown a marked decline in recent years. For example, in the year 1947, from January 1 to September 2, we have performed 32 pneumonectomies for tumor with two deaths, an operative mortality of 6·2 per cent. This mortality should serve to remove the idea too prevalent in the medical profession that the operation carries a prohibitive mortality. Similar low mortality rates have doubtless been achieved by other thoracic surgeons.

Of greater interest, however, than the number of patients who survive the operation is the question of how many survive a five-year period. There would be no good reason to subject a patient to such an operation if there were no chance of a five-year cure. Because the operation is so relatively recent I have been unable to find in the literature any statistical reports of five-year survival rates. Some reports of three-year cures have been published but these are probably of not such great significance as the five-year survivals. I can therefore present only our own figures.

Of 53 patients who had pneumonectomies for malignant tumors prior to 1942, in other words more than five years ago, 15 are alive and well. This is a five-year survival rate of 28 per cent. But in the early years we had an operative mortality of 53 per cent., which means that 28 patients did not survive the operation. Accordingly, if we correct for that figure we find that actually of the 25 who survived the operation 60 per cent. are living more than five years. This statement, however, needs some explanation because there is a remarkable, indeed to us an incomprehensible, lack of agreement among surgeons and even pathologists as to what constitutes a bronchiogenic carcinoma. More will be said about this feature presently. Suffice it here to say that of the 15 patients alive and well more than five years, three had typical squamous carcinoma, three had undifferentiated lesions, and nine had what we designate as mixed tumors showing invasive features. Some of this last group of tumors might be called adenomas by others and some of them adenocarcinomas. Of the three squamous cell cases regional lymph nodes were invaded in one, and of the nine mixed tumors regional nodes were involved in five. The following tables show a further breakdown of this information. The numbers involved are too small to be of much, if any, statistical value. Yet I think they are encouraging as showing that a patient with bronchiogenic carcinoma, even with involvement of regional

lymph nodes, has a fair chance of a five-year survival if he has a pneumonectomy.

TABLE 1

PERCENTAGE OF FIVE-YEAR SURVIVAL
(Uncorrected for Operative Mortality)

	Malignant Mixed Tumor	Squamous Carcinoma	Undifferentiated Carcinoma
Patients alive five years ..	9	3	3
Total pneumonectomies ..	16	22	15
Per cent. cure for five years	57	14	20

TABLE 2

PERCENTAGE OF FIVE-YEAR SURVIVAL
(Corrected for Operative Mortality)

	Malignant Mixed Tumor	Squamous Carcinoma	Undifferentiated Carcinoma
Patients alive five years ..	9	3	3
Patients leaving hospital alive	11	10	4
Per cent. cure for five years	81	30	75

TABLE 3

PERCENTAGE OF FIVE-YEAR SURVIVAL WITH INVADED LYMPH NODES

	Malignant Mixed Tumor	Squamous Carcinoma	Undifferentiated Carcinoma
Five-year survival with positive nodes	2	1	0
Total pneumonectomies with positive nodes ..	5	12	3
Per cent. alive five years with positive nodes ..	40	8	0

I have already mentioned the lack of agreement which exists among pathologists as to what constitutes a bronchiogenic carcinoma. Various classifications based on the morphological characteristics have been

proposed from time to time. Perhaps the most commonly used one is (1) the squamous cell or epidermoid carcinoma, (2) adenocarcinoma, (3) small cell or oat cell carcinoma and (4) undifferentiated cell carcinoma. Except for the squamous cell or epidermoid type which is usually easily distinguishable, it is very difficult in many cases to place a tumor in any of the other standard types because often different sections of the same tumor will exhibit a markedly diverse morphology which might permit one to label it with any of the names other than the squamous cell variety. Too rigid classifications based on morphological differences are well known to be misleading and nowhere does that statement apply more aptly than in the case of bronchiogenic carcinoma.

The whole situation here is particularly confused because of the tumor which most often goes under the name of bronchial adenoma. This tumor nearly always occurs in a primary bronchus or close enough to one to permit visualization by the bronchoscope. It often produces obstruction of the bronchus with its attendant complications. Women are slightly more often affected than men, a feature which is in marked contrast to the overwhelming preponderance of squamous bronchiogenic carcinoma in men. Frequently the symptoms of so-called adenoma date from adolescence and sometimes even from childhood. On bronchoscopic examination a smooth rounded mass, often pink, is seen projecting into the lumen. It is usually attached to the bronchus by a broad base and often a considerable portion of the tumor is outside the bronchus. In some cases the portion which is outside is much larger than that which is within the lumen. In this respect it may be said to resemble an iceberg which has only a small portion above the surface of the water. This fact is of great clinical importance because it indicates the futility of many attempts to remove the tumor through the bronchoscope. It is often associated with other developmental abnormalities of the lung, for example, either absence of interlobar fissures or excessive lobulation, congenital cystic disease, or abnormal bronchi.

The microscopic appearance of these tumors is generally characteristic. There is a covering of bronchial epithelium which often has undergone squamous metaplasia. Beneath this there is a layer of fibrous tissue which is variable in thickness. The main portion of the tumor is composed of cells with scanty cytoplasm and small, round, darkly staining nuclei in which mitotic figures are rarely seen. These cells are often arranged in such a manner that the resemblance to fetal pulmonary alveoli is very striking. Attention to this similarity was first called by Churchill[15] who reported it as an observation of Bremer of the Department of Anatomy at Harvard. These alveoli are separated by a stroma which consists chiefly of blood vessels and loose edematous tissue. In some cases the cells are arranged in cords giving the impression of a hypernephroma. It is our opinion that in many cases diagnosed as metastatic hypernephroma of the lung the true condition is a so-called

bronchial adenoma. Sometimes the stroma is so vascular that an impression of an angioma may be gained. The diagnosis of endothelioma has often been made in such cases. In some tumors the stroma has been dominated by cells of mesoblastic origin with the result that areas of fibrosis, smooth muscle, fat, fibrous and hyaline cartilage, and even bone have been seen. An important feature of these tumors is that in many of them sections taken from different portions reveal very different appearances. In places there is a small amount of stroma and the epithelial cells are larger, giving an impression of malignant growth. In some areas a glandular arrangement may be suggested and a diagnosis of adenocarcinoma made. Again the alveolar arrangement of the epithelium may give rise to the term " alveolar carcinoma."

The very close resemblance to fetal lung which some of these tumors have perhaps furnishes a clue to their origin in that it suggests that they are derived from disorganized embryonic bronchial buds which have failed to pursue a normal development. Also their position in the walls of the larger bronchi is suggestive of such an origin.

The fact that many of the so-called bronchial adenomas have characteristics like those observed in some tumors of the salivary glands which are generally called " mixed tumors " led Womack and me[16] in 1938 to designate them as " mixed tumors of the lung." It would be out of place to recapitulate here the argument in favour of that conception. It may be said, however, that in accordance with that idea it is our belief that in many cases of chondroma, fibroma, lipoma, myxoma, and even sarcoma of various types found in the lung the origin of the tumor has been the same as that of the so-called adenoma or " mixed tumor " of the bronchus, but in which the connective tissue or mesodermal elements have proliferated without a corresponding proliferation of the epithelial tissue.

Albrecht[17] in 1904 coined the term " hamartoma " in connection with a tumor of the liver by which he meant to express the opinion that it was the result of an abnormal growth of the normal structures of the organ. In line with Albrecht's conception of " hamartoma " we have felt that many of the tumors of the bronchi and lungs result from the failure of embryonic bronchial buds to develop into normal structures, and in our 1938 article we called attention to the similarity of our own conception of the origin of these tumors to that of Albrecht for the tumor of the liver described by him. These bronchial buds consist of both entoderm and mesoderm. It would seem reasonable, therefore, to consider that tumors might appear in adult life which had their origins in either embryonic entoderm or mesoderm. In accordance with our ideas either of two main groups of tumors can be thought of as occurring from a failure of a bronchial bud to develop into a normal adult arrangement of tissues. These two groups are (1) those in which the mesodermal elements predominate and (2) those in which the entodermal (or epithelial) elements

are dominant. The former group then would include such tumors as those which are usually designated as chondroma, osteoma, fibroma, lipoma, angioma, myxoma and sarcoma. The second group is illustrated chiefly by the so-called adenoma. This would explain the frequency of the occurrence of epithelial elements in so-called chondroma of the lung (see for example, McDonald, Harrington and Clagett)[18] and mesodermal elements in the epithelial tumors or adenomas. There may even be a malignant proliferation of both mesodermal and epithelial elements in the same tumor. Womack and I[19] have reported a case of a papillary tumor protruding from the right upper lobe bronchus which microscopically proved to be a combined carcinoma and sarcoma.

Names and theories of development of the bronchial adenoma are not so important as it is to have some common understanding and agreement about its clinical course. In our article of 1938[16] we advanced the opinion that the tumor is potentially malignant and we reported seven cases out of a larger group in which either invasion of adjacent tissues or involvement of regional lymph nodes had occurred. Kirch,[20] Malkwitz[21] and von Pein[22] had each previously reported cases of malignant transformations of " adenoma " or " polyp," but little attention was paid to their reports. The opinion which we expressed nine years ago that these tumors are potentially malignant was not generally accepted and even now there is much scepticism on the part of some pathologists. Let me refer to two rather recent articles. Foster-Carter[23] of the Brompton Hospital in 1941, from a study of 22 cases, states that he has found no evidence of malignancy except perhaps slight invasion of the bronchial wall in a few instances. He says there has never been recorded a case with distant metastasis. More recently (1944) Engelbreth-Holm[24] of the University Institute of Pathological Anatomy of Copenhagen in an article entitled " Benign Bronchial Adenomas " comes to the conclusion that " in rare cases " the adenoma may undergo malignant transformation, although in all of his 12 cases there was marked invasive growth and in two cases (17 per cent.) there were what he considered definite evidences of malignancy. But more cases are constantly turning up in which there is incontrovertible evidence that these tumors may become malignant and give rise to local and distant metastasis. In 1942 Adams, Steiner and Bloch[25] reported five cases under the designation of " Malignant Adenoma of the Lung." In one of their patients there was a metastasis to the vertebral bone marrow ; one had metastases to both the mediastinal lymph glands and to the liver ; in another there was involvement of a tracheobronchial lymph gland ; and in two the bronchial wall itself was invaded. Anderson[26] of the Department of Pathology of Washington University has recently reported a case in which there was a metastasis in the liver. Stowell[27], also of our Department of Pathology, in an unpublished case of an autopsy at the St. Louis County Hospital, has found a metastasis in a regional lymph gland.

In a paper presented to the American Association for Thoracic Surgery in 1945 Womack and I[19] reported two cases in which autopsy was performed after bronchoscopic biopsies had established the diagnosis of so-called adenoma. In both cases metastases were found in the liver. In one case the bronchoscopic biopsy had been made four years prior to the death of the patient. There is also the case of Burrell and Negus[28] here in London, unfortunately not reported in satisfactory detail, in which a " fibro-adenoma " had been removed by Mr. Negus through the bronchoscope and " several years after the operation carcinoma of the bronchus developed and the patient died."

In the discussion of our 1945 paper at the same meeting of the American Association for Thoracic Surgery, Bigger[29] cited a case of his in which he performed a pneumonectomy on a man, 48 years old, who had a history of recurring pulmonary hæmorrhages for 20 years. The removed lung showed the presence of not only an adenocarcinoma but involvement of the regional lymph nodes as well. Bigger's conclusion was that because of the long history of hæmorrhages it seemed likely that the case was an example of a malignant transformation of an adenoma. John Alexander[30] stated that in a series of 13 cases he had had two with lymph node metasstasis. In the paper of Chamberlain and Gordon,[31] published in the same issue of the Journal of Thoracic Surgery, a report is made of 10 cases of " bronchial adenoma " of which five had lymph node involvement.

Is it necessary to cite more examples to show that the so-called adenoma may undergo malignant transformation ?

Those who deny this possibility offer several objections to the idea. First they say the long history of symptoms often associated with an adenoma indicates that it is not malignant. We do not deny that many of these tumors fail to develop malignant features, but we are convinced that many of them do undergo a transformation into a malignant tumor and that therefore the potentiality of such a transformation always exists. Furthermore, it is not possible to tell from the microscopic appearance alone whether or not the tumor is already malignant, as many competent pathologists will testify. The bronchoscopic biopsy, therefore, may not be conclusive on this point.

Another argument that is frequently raised is that in a particular individual's experience (as for example, Foster-Carter,[23] Chevalier L. Jackson,[32] and others) he has never seen convincing evidence that the adenoma has undergone a malignant change. Is it not possible that when this change has occurred he has not recognized the finished product as having started as a so-called adenoma ?

Let us examine this question further. If we should imagine that a malignant change might occur we might expect that the prevailing type of epithelial cell would be one that is small, round, with scanty cytoplasm and darkly staining nucleus, in other words the type of cell found in the adenoma. This corresponds very well

with the predominating type of cell which is found in two very common kinds of bronchiogenic carcinoma, designated according to orthodox pathologic standards as (1) " round cell " or " oat cell " carcinoma or (2) " undifferentiated cell " carcinoma. Again, the morphologic resemblance of many adenomas to adenocarcinoma has frequently been mentioned, in some cases even by those who deny the potential malignancy of this tumor. Moreover it seems strange that before the general use of the bronchoscope the adenoma was a very rare tumor in contrast to its comparative frequency now. In his excellent review of the literature Foster-Carter [23] states that until Kramer [33] in 1930 recognized the first case during life only three cases in all had been described and those were found at necropsy. Even now it is rare to find an adenoma at postmortem examination. Is there not perhaps some explanation of the fact that many are diagnosed during life but few after death? Womack and I venture to suggest that the reason may be that because of the transformation of many of these tumours into carcinomas they are diagnosed as that at the autopsy table and their origin as adenomas is not recognizable.

It has already been mentioned that the so-called adenoma is frequently found associated with other congenital anomalies of the lung. Likewise we[34] have found in three of nine patients operated upon for congenital cystic disease of the lung microscopic evidence of abnormal epithelial overgrowth consisting of masses of poorly differentiated epithelial cells having an invasive tendency but showing no metastasis. It seems possible that this condition might go on into the development of unquestionable carcinoma. Also in another article we have reported four cases of cancer of unclassifiable morphology associated with developmental pulmonary abnormalities of different types. In one of these cases there appeared to be a multicentric origin and the mucosa of the main bronchus presented an appearance, previously mentioned by Lindberg[36], of many areas suggestive of a precancerous condition. This case likewise seems to suggest that there is no morphologic difference in cells between bronchiogenic carcinoma arising from the mucosa and that arising from the glandular ducts.

The practical importance of all this discussion on the so-called adenoma concerns the question of its treatment. There is no doubt that many have been successfully removed through the bronchoscope (Jackson,[32] Brock,[37] etc.). Others have been treated successfully with radon seeds (Edwards,[38] Brock[37]). In our opinion, however, they are best treated by radical surgery, either lobectomy or pneumonectomy. As has already been stated, one cannot be sure from the bronchoscopic biopsy whether or not the tumor has already become malignant. Again, the bronchoscope will not reveal how much of the tumor is extrabronchial. Finally, so often extensive bronchiectasis is present that radical resection will be required for that reason alone. Although I have performed several lobectomies for the condition, my own preference is for total pneumonectomy. A much better opportunity for the removal of involved lymph glands is

presented in the operation of pneumonectomy than in the less radical lobectomy. Many other surgeons, however, think this recommendation is too radical. Perhaps more experience will disclose that it is.

Improvement in the results of the treatment of bronchiogenic carcinoma will probably come chiefly from the application of the operation of total pneumonectomy to earlier cases. This statement naturally involves the question of diagnosis. Unfortunately in some cases no symptoms arise to make the patient suspect that anything is wrong until the condition is too far advanced to be resectable. This situation is found especially when the tumor is in the superior sulcus or has arisen in a smaller bronchus. In most cases, however, the warning symptoms are cough and blood-streaked sputum. If a middle-aged man without tuberculosis or bronchiectasis expectorates blood the presumption is strong that he has a bronchiogenic carcinoma. He should be promptly investigated for that condition. The ordinary X-ray examination is often of great value and it should be made as a routine in all suspected cases. Sometimes the tumor itself can be seen in that way but in most cases only suspicious shadows in the hilar region or an atelectatic portion of lung resulting from bronchial obstruction can be seen. A bronchogram with lipiodol will often be more revealing by showing an obstructed bronchus. The most direct diagnostic procedure, however, is bronchoscopy. When the carcinoma can be actually seen and a piece removed for confirmatory biopsy the diagnosis is established. But unfortunately the tumor cannot always be seen because of its location, out of reach of the bronchoscope. In our own experience we are able to visualize the growth in only about 65 per cent. of cases. Other methods can be used. For example, we have found the examination of the sputum for cancer cells, as advocated particularly by Barrett[39] and by Wandall,[40] to be of very great value even in early cases, but it is necessary for the examiner to be expert in the recognition of the cells and to have an extraordinary amount of patience. The procedure recently employed by Herbut and Clerf[41] of using the method of Papanicolaou for staining the secretions obtained through the bronchoscope seems promising. In 30 consecutive cases of bronchiogenic carcinoma cancer cells were demonstrated by them in the secretions of 22 patients (73 per cent.), although in the same series only 11 positive (36 per cent.) diagnoses could be made through the study of removed tissue. Finally there is the exploratory operation. We do not hesitate to carry out this procedure in the absence of a positive diagnosis if there is strong clinical evidence. We have rarely been wrong in our clinical impressions. We have, however, sometimes resorted to the use of a frozen section at operation. Very rarely in cases of suspicious X-ray shadows situated at the periphery near the chest wall we have used the method of punch biopsy with an aspirating needle, but we prefer not to use it. I shall not discuss the establishment of the diagnosis by the recognition of metastases or other complications, such as tumor cells in the pleural fluid.

One of the most distressing features of the whole problem to the surgeon is the large percentage of the patients who present themselves too late for a radical resection. Of a total number of 1,024 cases with a clinical diagnosis of bronchiogenic carcinoma, we have seen 260 since January 1, 1945, to August 1, 1947. Of this latter group we were able to carry out a pneumonectomy in only 58 cases, or 22·3 per cent. In 83 cases (32 per cent.) we performed an exploratory operation but found the cancer too far advanced to permit resection. In 70 cases, although the diagnosis was established, the condition was regarded as hopeless and not even an exploration was advised. In the recent series of 260 cases a positive (microscopic) diagnosis was made in 211 cases (81 per cent.). In the remaining 49 cases, although the clinical impression was strong, the patients were not subjected to exploratory operation because of advanced age or other conditions which made it seem unlikely that a radical operation would be tolerated even if a carcinoma were found. In a recent article Coleman[42] has reported his experience in greatly extending the indications for radical resection. In five patients with involvement of the ribs he has combined a total pneumonectomy with a block excision of the chest wall. Three of the patients are living and well, one for six years, one for two years, and one for five months. In all the cases the type of carcinoma was the squamous cell variety. Probably many thoracic surgeons have carried out this procedure to some extent. I have done it myself in one instance but the patient was dead within a year. Probably a more extensive trial of it is indicated in view of Coleman's gratifying results.

At this point perhaps some brief remarks are in order about operative technique. Rienhoff and others prefer an anterior incision. At the Barnes Hospital the routine procedure used by Burford and me is similar to the operation described by Crafoord.[13] Our incision usually involves the removal of the fifth or sixth rib from the transverse process to the costal cartilage. We prefer to ligate the pulmonary artery before ligating the two veins in order to diminish the amount of blood in the lung. When dealing with the large vessels it is our custom not to place a clamp on the heart side. Instead we pass a No. 2 chromic catgut ligature around the vessel which is tied as close to the heart as possible. Another similar ligature is passed around the vessel and while an assistant exerts gentle traction on the first ligature the second is tied behind (towards the heart) the first. A long Ochsner clamp is then applied to the lung side of the vessel grasping some lung tissue as well as the vessel. The vessel is now cut through by shaving along the clamp. Even on the right side where the vessels are short this procedure gives a comfortable stump of from one-quarter to a half inch in length. This stump is then transfixed with a suture of silk. Sometimes of course it is necessary to enter the pericardium in order to obtain a safe length of vessel. Before cutting across the bronchus we compress it with a clamp which does not crush it. The purpose of this procedure is two-fold. One is to have the anæsthetist

note the respiratory exchange in order to be sure that the trachea has not been mistaken for the bronchus, an error which can occur in a difficult case. The other purpose is to prevent the aspiration of blood into the open end of the bronchus as well as to diminish contamination of the pleural cavity. The aspiration of even a relatively small amount of blood into the open bronchus may result in the formation of a clot, which, if it gets into the remaining lung, may have serious or even fatal consequences by causing bronchial obstruction. If no disturbance of the respiratory exchange is noted another more distal clamp is applied and the bronchus is transected between the clamp. The lung is then lifted out of the chest and the field made dry. The clamp on the proximal end of the bronchus is removed after placing two stay sutures through the wall opposite each other. At this point sometimes vigorous bleeding from the bronchial artery occurs which then must be caught and tied separately to prevent aspiration of blood into the open bronchus. As already mentioned our usual method of closure is to make first a row of mattress sutures with silk followed by another row of interrupted silk sutures across the open end. Some surgeons prefer to reinforce the suture line with a flap of pleura, either as a pedicle flap from the posterior chest wall or as a free graft. We have tried this procedure extensively and from our own experience we have concluded that it has no special merit. In our opinion the best prevention against a subsequent leak is careful suturing and the liberal use of penicillin, because it seems to us that most leaks are due to an infection of the bronchus. As a routine procedure we inject 100,000 units of penicillin into the chest cavity after the closure of the chest wall which is repeated every day during the first week, supplemented by an equal parenteral dose daily for two weeks after the operation. The great gift to the world of penicillin by your Fleming and Florey has made a tremendous difference in the incidence of bronchial leaks.

In nearly all cases we make a bronchoscopic examination before the patient leaves the operating room to be sure that the air passages to the remaining lung are free from blood clots or plugs of mucus.

As an anæsthetic we prefer cyclopropane which is administered through an endotracheal catheter. Blood is transfused continuously during the operation through needles in two veins. The reason for using two veins instead of a single one is that sometimes one vein becomes stopped up or one apparatus ceases to function. The other vein therefore constitutes a reserve. Ordinarily we give 1,000 or 1,500 cc. of whole blood. In most cases the patient gets up out of bed on the day following operation and he is discharged in two weeks.

One of the difficult problems that confronts the surgeon is what to do for the patient whose lung for various reasons cannot be removed. This of course concerns the larger problem of the treatment of hopeless cancer in general. We must not break the patient's morale completely by giving him the impression that nothing can be done for him. It is our custom to

advise X-ray therapy, although only in very rare cases have we seen any good come from it. To forestall disappointment at not noticing prompt improvement we usually tell the patient not to expect any noticeable result for at least six months. By that time he is usually resigned to his fate.

During the last four months we have been applying a new principle to the treatment of these hopeless cases. Since bronchiogenic squamous carcinoma is overwhelmingly a disease that affects the male sex (six or seven times as frequent in the male as in the female) it occurred to us that perhaps some beneficial results might be obtained by treating male patients with female sex hormones. During the last four months, therefore, we have been giving stilbestrol to a selected group of 15 men with inoperable bronchiogenic carcinoma. The dose which we are using is five milligrams three times a day. The procedure has been too recent to arrive at any conclusions or to mention any statistics. All that can be said now is that there seems to be some evidence that it may delay the progress of the condition and make the patient more comfortable. No further conclusion is justifiable at this time. The new substance "methyl-bis"[43] which is being tried by others in these cases in our opinion offers nothing encouraging and may make the patient much more uncomfortable.

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JOHN HUNTER AS A PSYCHOLOGIST

by

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HUNTERIAN ORATORS, at one time or another, have dwelt on all aspects of the many sided Hunter save one; his role as a psychologist. This neglect may be explained on several grounds. The first is that his psychological observations are not to be found in Palmer's edition of his works (1837), the source from which orators usually draw their information. The second and more important reason is the unfinished and scrappy state in which Hunter left his notes on animal and human mentality. At the end of a busy day he would jot down, to serve as remembrances, rough notes on observations he had made on the workings of his own mind, or points which he had noted in the minds of those he had been in contact; or, if he had been at his farm at Earl's Court, the conduct of wasps, bees, fowls, horses or cattle. Some of these he went back to and worked over as for publication, but many remained in the rough, intelligible to himself, but not to others. After his death in 1793, William Clift, who was then in charge of his collection, studied these notes and took copies of many of them. Most of Hunter's papers, as my readers already know, were burned by Everard Home, Hunter's brother-in-law and also trustee. Clift's copies were preserved; in 1861, Richard Owen edited these notes and included them in Volume I of "*Essays and Observations,*" by John Hunter. This volume is the source of most of my statements; the numbers within brackets in my text refer to the pages which corroborate my statements.

To deal adequately with Hunter's psychological observations would require a volume, not a brief article such as this. Hence I am to limit myself to passages which have a special bearing on Hunter's personality or which have a significance for modern students of human and animal nature. My first instance is taken from a passage in which Hunter is discussing the nature of consciousness (p. 252). It refers to an early attack of angina pectoris.

> "A man's feelings of himself, or consciousness of his body, is not sensation; for, when I was ill, my own feelings of myself, with regard to size, was . . . only two feet high, while the sensitive or reasoning principle (faculty) told me I was as tall as usual." (Hunter's height was 5ft. 2in.)

A clearer light on his conception of consciousness is given in the three instances which follow—all of them, I infer, based on personal experience.

"We often think of an act, and set about it, but in part forget it; and we go on with the act without being conscious of it; and if no circumstance or effect tells us that we have done it, we do not know that we have done it. A man shall remember to wind up his watch, and shall set about it; but another thought will interfere; yet he shall go on winding up the watch, put it in his pocket, and immediately ask himself whether he wound it up or not; he only remembers having thought of it" (p. 252).

Hunter, being an habitual thinker, had frequently experienced "absence of mind" or as he implies, a switch of consciousness from one object to another. The mind must be in a conscious state to record an impression as a memory. There is a touch of humour in the second instance, related on the same page.

"If he was to think of taking off his shoes, and another idea should come into his mind, but he should still go on taking them off, he would not need to think whether they were off or not, for he would immediately find them off as soon as he thought about it."

The third instance is somewhat of a different nature (p. 253).

"In another case the effect of the action shall not be exactly what was premeditated. For instance, I intend taking something into another room or to some person; and instead of the thing intended, I take something else very different, a something probably I should not by any means have taken. This is what is called 'absence of mind'."

Hunter goes back time after time to illustrate the influence which mental states, such as that of anxiety, have upon the involuntary functions of the body. Here is a personal reminiscence of such a state (p. 257). Anxiety he regards as "expressive of the union of two passions—desire and fear."

"The mind is often in opposition to itself; one state of mind, if strong, shall get the better of another state which is weak, or the stronger state will not allow the weaker to rise. . . . Nothing could show this better than two interesting facts which took place within myself, both happening at the same time. I went to see Mrs. Siddons's acting. I had a full conviction that I should be very much affected; but unfortunately I had not put a handkerchief in my pocket; and the distress I was in for the want of that requisite when one is crying, and a kind of fear I should cry, stopped up every tear, and I was even ashamed I did not, nor could not cry."

Clearly Hunter had a vein of sentiment which his printed lectures fail to reveal. The next instance is a further illustration of the influence of the mind on the body. In this case Hunter claims to have relieved his anxiety syndrome by directing his mind to pleasant thoughts.

"When I had spasm of the heart upon the smallest exertion of the body, as in walking up a small ascent, or in the least anxiety about an

event, such as bees swarming, yet I could tell a story that called up the finer feelings, which I could not tell without crying, obliging me to stop several times in the narration, yet the spasm did not in the least take place. Therefore those feelings of the mind we have for other people are totally different operations of the mind from that of anxiety about events, whether of our own or of others; because its effects on our bodies are very different" (p. 266).

The next matter I am to mention is one in which I have a personal interest. In early manhood I suffered much from malarial fever. At the height of an attack, when sweating began and my temperature to fall, my head commenced to throb and blood seemed to rush through my brain. It was then that my imagination became crowded with images, semi-delirious in nature, which raced along in an endless train, ceasing when my temperature fell and sleep brought relief. I think people of an optimistic outlook on life are particularly liable to these excited states of the imagination when in fever but people with high blood pressure are subject to similar attacks when in normal health. Hunter, we have reason to think, was a man of a sanguine temperament and a high blood pressure. The following passage shows that he was familiar with these semi-delirious states of the mind (p. 258).

"In many persons the mind hardly ever loses the susceptibility of a lively impression, and therefore they conceive such to be more than they really are; and I believe that such as have a lively imagination move quickly from object to object. This I believe to be a state of half delirium; I have felt this when much affected. Whatever I conceived in my mind became, at such time, almost a reality."

The next passage I am to cite interests me because it confirms an early experience of my own. When teaching anatomy to students at the London Hospital I was surprised to discover that nearly half of them picked up their knowledge through their ears. That was a revelation, for I had supposed that all were like myself, eye-learners. Hunter, who was also an eye-learner, had met with the same experience among his 18th-century students (p. 165).

"The intellect or understanding has an immediate connexion with the senses, and the senses with the intellect. But we find that the different senses have not always the same share in this connexion; some sense being capable of informing the intellect much more than another, and the intellect using that sense upon every occasion, and neglecting the others. To explain this by example: we find that some people cannot pay attention to what they hear, but search for objects of sight, in order to be informed by the eyes. These retain what they do see and can readily reason from it, while they lose connexion and forget the half of what they hear."

Then follows a passage which reveals Hunter's sense of humour (p. 165).

> "If it were possible to have more senses than we have, it is very probable we might lose by the gain. We are certainly not capable of managing more variety of sensations than we have at present, and many are not capable of managing those. Take away a sense from some, they would be tolerably sensible."

Hunter drew a sharp distinction between "thinking" and "reasoning" as is made clear in the following passage (p. 265).

> "Thinking is natural, but reasoning is not; we can think without reasoning. Thinking is the forming of ideas. They may have a connexion with each other, so as to keep up a relationship, which might be called 'natural reasoning.' But reason is a kind of voluntary act; the mind brings itself to it. The first thing we lose when we are losing the consciousness of ourselves is the power of thinking. When we think we can reason."

This is a fair example of the contracted sentences in which Hunter jotted down his personal thoughts. The meaning, in this case, is clear. When the "mind" automatically handles its ideas, it is "thinking" according to Hunter; when the will is called in to direct operations, then the "mind" is engaged in "reasoning." Hunter makes no mention of the strain and sense of effort which I experience when engaged in reasoning and reducing my reasons to writing; yet I suspect he found reasoned composition an exhausting operation. I know writers who declare that "reasoning" as defined by Hunter is both exhilarating and refreshing. My own experience is the opposite.

Hunter was evidently speaking from personal experience when he penned the phrase—"Meanwhile, the charm of discovery is our own" (p. 340). The thrill of discovery was for him a common experience. He knew, as the following quotation will prove, that discovery usually comes, not from planning or reasoning, but from the occurrence of a fortunate combination of circumstances. To understand the paragraph I am to cite (p. 91) it is necessary to know that Hunter was anxious to discover where queen wasps spent the winter months.

> "Many things are discovered when in pursuit of something else, more especially if it is a subject we may at the time be engaged in. It was one of the orders I had given my gardener that, when he was digging in the winter, he would be attentive to what he dug, and see if he ever dug up a wasp, hornet or bumble-bee. In digging a dry bank about the beginning of April, he dug up three wasps alive; they were in holes like worm-holes, not a great way from the surface."

While removing a "dry bank" at Earl's Court Hunter's gardener "discovered" where queen wasps spent the winter. Another pertinent circumstance which attends discovery is given by Hunter in the following apothegm: "The most obscure facts are the most promising sources of investigation" (Palmer's Edition, Vol. 3, p. 388).

I have mentioned the thrill which seizes the mind at the moment of discovery. It diminishes with age, as Hunter knew.

"Everything that gives pleasure at first, lessens by practice, and everything that gives pain, becomes more easy" (p. 278). "The mind is formed by habit, as the body is. The body may be made to endure many things, as fatigue, heat, cold, etc., without invonvenience to itself, or without making the mind sensible of it. The mind may be made to endure almost anything, and it may be so humoured as hardly to bear any inconvenience" (p. 264).

These extracts reveal Hunter in the role of philosopher rather than in that of psychologist. In the following passage he is both psychologist and philosopher :—

"Perhaps there is nothing in Nature more pleasing than the study of the human mind, even in its imperfections or depravities; for, although it may be more pleasing to a good mind to contemplate and investigate the applications of its powers to good purposes, yet as depravity is an operation of the same mind, it becomes at least equally philosophical and equally necessary to investigate, that we may be able to prevent it" (p. 268).

He adds: "When we consider the mind of man as possessing a thousand qualities, each being more or less contrasted by its opposites . . . we must be sensible how complicated the mind is" (p. 268).

Although nowhere does Hunter handle the idea that underlies the modern conception of evolution, yet from his insistence on man's mentality being based on instinct, such an idea does seem to have occurred to him. "All animals," he insists, "are ruled by natural and instinctive principles. . . . Animals may be compared with one another in their facility to learn, the human being at the head" (p. 39). This idea is expanded in the following passages (pp. 276, 277) :—

"Whatever impulse of action we have which does not arise from the knowledge of the event, or from a motive, is an instinct. And whatever action arises from an intention, is reason. . . . I conceive that monkeys have more instinctive principles than dogs. . . . And if man could lay aside acting from reasoning, his instinctive principles would be more extensive than any; but the actions arising from instinct are so heightened and made so much more perfect, that the instinctive actions appear, even to the mind of the persons themselves, to be wholly the result of reason."

In that passage I think Hunter utters a truth of the highest importance concerning the nature of man's mentality. Human proclivities and biases are modified and evolved instincts. Especially is this seen to be true when we regard the collective actions of mankind.

At the end of the section of "*Essays and Observations*" which Owen devoted to psychology, there are appended loose notes under the heading

"*Miscellaneous Notes and Apothegms.*" Some of these have a special interest because of the light they throw on Hunter's personality. From what I know of Hunter I would describe him as an ambitious man, meaning by that term the desire which a man has to excel and to earn the esteem of his fellows. Hunter evidently attached a sinister meaning to the term for he defines "ambition as a species of vanity; it is wishing or aiming at something beyond its powers" (p. 279). In such a sense Hunter was not ambitious; his aims and his powers or capacity were well matched. Yet that his just ambition was great is shown by the following passage (p. 275):—

> "No man wishes to die, to be eternally forgot; what he leaves he considers, or he feels, in some degree perpetuates his memory which is a means of incitement to great and good actions; and yet it is not in human nature to do good perfectly disinterestedly: he likes to have a share. . . . He is desirous that his son should come in for a share; he wishes the son should be known to be the son of that man."

Hunter had thus his share of human vanities; he left a "feckless" son, a vast collection of specimens, and a not inconsiderable collection of debts; above all, he left a name and an example that only men of the highest genius can hope to copy. I am sure he was thinking of his own case when he wrote (p. 280): "It requires a great deal of courage in a man to continue poor while it is in his power to get rich."

The passage I now cite brings out Hunter's strong individualism; he was not framed for a time in which socialistic ideas prevail (p. 275).

> "Every man feels a desire to have property, and every man has a right to have property; and every man feels a desire to dispose of it when he can enjoy it no longer; and as it is his property he has a right to dispose of it. . . . The property goes on in succession . . . a kind of reward for industry."

There is an omission of a name from Hunter's notes of psychology which has always puzzled me—that of David Hume. When Hunter was still a lad, living and learning on his father's farm at Long Calderwood, David Hume was exploring the labyrinths of human nature on the banks of the Tweed and setting down in the clearest of terms the results of his enquiry. I find it difficult to believe that Hunter never consulted Hume's treatises which already covered the whole field he gave himself to. I attribute this omission to Hunter's individualism—his vanity to be the father of all the ideas on which his conclusions were founded. I cannot trace any single item which he could only have obtained from Hume's pages. No, Hunter was never a plagiarist; his own cerebral mint could turn out all the coin he needed in his undertakings.

There is another aspect of Hunter's personality which interests me and which no one, so far as I can learn, has ever remarked. He reached manhood in Scotland; he was twenty years of age when he came to

England; he retained the accent of the south Scot; he always spoke of "rooks" as "crows," just as I do, and I have lived longer in England than Hunter did. Scots were very unpopular in England during the earlier years of Hunter's residence.

I have never come across any expression which reveals in him any kind of partiality for his native country—which is a very uncommon defect in Scots who live south of the Tweed. The explanation I offer is this. In the 18th century, learned and professional men in all the capitals of Europe prided themselves on their cosmopolitan outlook and manners. Love of one's native land was regarded as a mark of the vulgar and uneducated. In this matter I suspect Hunter aimed at being a cosmopolitan. Among the learned men of to-day there are many who would justify Hunter's attitude towards nationalism. All the same I could have loved him more if he had been a better Scot.

HUNTER'S BUST IN LEICESTER SQUARE

FROM 1785 until his death in 1793 Hunter lived at 28, Leicester Square, the house next to the old Alhambra—now the Odeon Theatre. There he housed and enormously increased his world-famous museum. It was therefore right and proper that when the garden of Leicester Square was laid out Hunter should be selected for commemoration. The bust of Hunter at the north-east corner was sculptured by Thomas Woolner. At the remaining corners of the garden were placed busts of three other famous residents there or thereabouts—Sir Joshua Reynolds, William Hogarth and Sir Isaac Newton—while in the centre was placed a statue of Shakespeare.

The bust of John Hunter in Leicester Square.

Leicester Square or Leicester Fields, as the space was formerly known, was so called because in the 17th century the only house in the neighbourhood was that built for Robert Sydney, Earl of Leicester. George III (who granted the Charter to the Company of Surgeons in 1745), while he was Prince of Wales, took up his residence at Leicester House when his father, George I, commanded him to leave St. James's, and excluded him from all court ceremonies.

In the 18th century Leicester Square was a district much favoured by painters. Sir Thomas Thornhill lived there, and his more illustrious son-in-law, William Hogarth, came up from Chiswick to die (October 26th, 1764) in his London house which was No. 30 at the south-east corner, where Archbishop Tenison's School now stands. As recorded in the epitaph by Samuel Johnson:

> "Here closed in death the attentive eyes
> That saw the manners in the face."

From 1761 to 1792 Sir Joshua Reynolds lived in No. 47 on the west side, and in St. Martin's Street off the south side Sir Isaac Newton passed some of the later years of his life. Hence the selection of these famous men for the memorial busts which were placed at each corner of the garden—Hunter, by Woolner, Hogarth by Durham, Newton by W. C. Marshall and Reynolds by Weekes. The statue of Shakespeare is a copy by Fontana of that in Westminster Abbey.

"Baron" Grant, who acquired Leicester Square, turned it into a garden and adorned it with the statue and busts. He rescued it from being a deserted and unsavoury area and in 1874 presented it to London. Grant was a pioneer among the exploiters of gullible investors such as doctors, parsons, and widows. Indeed it is estimated that in a few years he extracted from the public over four million pounds. Shortly after his gift of Leicester Square the fraudulent character of this financial buccaneer was exposed. Bankruptcy followed and a life of seclusion until his death in 1899. Grant's real name was Gottheimer and he acquired his barony from the King of Italy. A contemporary epigram of his days of prosperity and ostentation ran as follows:—

> "Though Kings can grant titles, honour they can't
> And titles lacking honour are a *barren grant*."

The bust of Hunter was seriously damaged in 1945 in the general excitement and exuberant rejoicing of "V.J." night. Damage was done to other busts, but in time all will be made good. Meanwhile, it will be gratifying to surgeons throughout the world to know that the Westminster City Council have had the bust of John Hunter restored. The work was entrusted to a sculptor recommended by the Ancient Monuments Board of the Ministry of Works. Its replacement is being deferred pending the removal of some underground air-raid shelters in the garden. The Westminster City Council have been informed that the Royal College of Surgeons will wish to be represented at any function that may be arranged in connection with the reinstatement of the bust of John Hunter.

A.W.-J.

Periodicals and their use

PERIODICALS FORM the largest and most important section of the College Library, as of every modern scientific library. The newest work in every branch of science and medicine is first published in periodicals and the provision of access to periodicals and of guidance in their use is a primary duty of an active library. There are now so many periodicals in currency, more than 2,000 in the medical sciences alone, that every library must be selective and specialised. On the other hand, the research worker may want to refer to a much wider range of periodicals than one library can provide for him. How is he to trace them? Inter-library co-operation, facilitated by union catalogues, makes it possible to supplement each library's own resources by borrowing from other libraries. Several of these union catalogues are available in the College Library to inform readers if and where any periodical may be seen. The most useful is the *World List of Scientific Periodicals*[1]. This includes all the medical periodicals, current between 1900 and 1933, which were known to be available in more than 50 British libraries, with indication of the libraries where each may be found. When a periodical is not available in this country, the French[2] and American[3] union catalogues often make it possible to obtain microfilm copies from abroad. To cover the years which have gone by since the *World List* was printed in 1934, the library has an unpublished card-catalogue of *Current Periodicals in five London medical Libraries*, namely the British Medical Association, London School of Hygiene, Medical Research Council, Royal College of Surgeons, and University College Medical Sciences Library. The information in this catalogue is available to readers by application to the library staff, and the College has a working arrangement with the other libraries, except the British Medical Association, for borrowing volumes which may be read in the College Library. For periodicals which ceased publication before 1900 recourse may be made to Professor R. T. Leiper's *Periodicals of Medicine in British Libraries*[4]. The catalogues of periodicals in individual libraries are also useful. The College's own catalogue[5] was printed in 1931, and a copy with additions up to date is available in the Reading Room, with the entries spaced out and pasted down in a large ledger, in the style of the British Museum Library catalogue. A revised edition on cards is in process of compilation. The Royal Society of Medicine's catalogue[6] of its large collection may also be consulted in the College Library.

These catalogues guide the reader to series of periodicals. How is he to trace precise references to special articles? Or how to discover what

has been written recently on a given subject? General indexes are available in the Reading Room, and the staff will help unfamiliar readers in using them. The principal one is the *Index Medicus*[7]. This appears in quarterly parts, the first and third of which are incorporated into the second and fourth each year, so that in the end there is one permanent index volume for each six months of publications indexed. Owing to after-war conditions the *Index Medicus* is now a year behind schedule and must be supplemented by using the *Current List of Medical Literature*[8], a weekly list with monthly indexes. The *Index Medicus* consists of a single alphabetical index to all medical periodicals in which each article is mentioned both under its subject and under its author's name; the *Current List* is a summary of the contents, issue by issue, of the periodicals which appeared in the week dealt with. For the older literature the four series of the *Index-Catalogue*[9] must be searched. Here the articles from periodicals are classified under subjects, each group of references covering about 20 years' publications.

The College Library is particularly well off in the periodicals of surgery, anatomy and physiology. Ophthalmological periodicals are also very fully provided, as is the journal literature of cancer research. Orthopaedics, pathology, biochemistry and neurology are well represented, and the number of dental journals will soon be enlarged. Specialist physicians' journals are not provided, though general medical periodicals are available in good number. Tropical medicine, public health, industrial medicine and psychology are not now collected, as they are readily available in other London libraries. The library has a great wealth of long series of the more important periodicals and is on that account specially useful to the reader with references to the old literature[10]. At the same time the current intake is regularly reviewed. A number of new periodicals have been added during recent years, among the most important of these are: *Abstracts of world surgery*; *Acta chirurgica belgica*; *Helvetica chirurgica acta*; *Plastic and reconstructive surgery*; *Thorax.*

Acta anatomica; *Anaesthesia*; *Anesthesiology*; *Experimental medicine and surgery*; *Gastroenterology*; *Journal of neurosurgery.*

British journal of cancer; *Journal of the National cancer institute, U.S.A.*; *Acta ophthalmologica*; *Ophthalmic literature*; *Acta physiologica scandinavica*; *Helvetica physiologica et pharmacologica acta*; *Journal of neurophysiology.*

Current issues of periodicals are displayed in the centre of the main Reading Room, and the bound series are round its walls. Readers are invited to help themselves if they prefer to do so, but to ask the help of the staff whenever they wish. They are also asked not to replace used books on the shelves.

REFERENCES

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7 *Quarterly Cumulative Index Medicus.* American Medical Association. The permanent issues cover January-June and July-December of each year.

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10 GUTHRIE, D. (1945) *A history of Medicine*, chapter 20, Journalism.

LE FANU, W. R. (1938) *British periodicals of medicine, a chronological list 1684-1938.* Baltimore.

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DIARY FOR NOVEMBER

(17th-28th)

Mon.	17	6.15	MR. T. CAWTHORNE—Aural Vertigo.
Tues.	18	6.15	MR. J. C. HOGG—Non-Malignant Strictures of the Oesophagus.
Wed.	19	6.15	MR. C. P. WILSON—Carcinoma of the Oesophagus.
Fri.	21	5.00	DR. I. HARVEY FLACK—Vicary Lecture—Lawson Tait.*
		6.15	MR. J. PENNYBACKER—Brain Abscess in Relation to Diseases of the Ear, Nose and Throat.
Mon.	24	3.45	MR. S. MOTTERSHEAD—The Blood Supply of the Hindgut.
		5.00	PROF. R. J. MCDOWALL—Shock.
Tues.	25	3.45	DR. J. WHILLIS—The Anatomy of the Oesophagus.
		5.00	DR. F. C. COURTICE—Oxygen and Carbon Dioxide Transport.
Wed.	26	3.45	MR. R. J. LAST—The Segmental Innervation of Limb Musculature.
		5.00	PROF. A. C. FRAZER—Fat Metabolism.
Thur.	27	3.45	PROF. J. KIRK—The Foetal Circulation.
		5.00	DR. D. J. BELL—Carbohydrate Metabolism.
Fri.	28	3.45	DR. P. R. PEACOCK—Experimental Study of Breast Cancer.
		5.00	DR. L. E. GLYNN—Hepatic Dysfunction.

* Not part of a course.

DIARY FOR DECEMBER

Mon.	1	3.45	DR. A. PEACOCK—Middle Ear and Eustachian Tube.
		5.00	DR. J. D. ROBERTSON—The Disordered Metabolisms in Thyrotoxicosis and Myxoedema.
Tues.	2	3.45	PROF. H. A. HARRIS—The Anatomy of the Bladder and Prostate.
		5.00	PROF. G. P. WRIGHT—Pathology of Primary Tuberculous Infection (i).
Wed.	3		L.D.S. Examination begins.
		3.45	MR. H. F. LUNN—The Flexor and Extensor Retinacula of Wrist and Ankle.
		5.00	PROF. G. P. WRIGHT—Pathology of Primary Tuberculous Infection (ii).
Thur.	4		Pre-Medical Examination and L.D.S. Examination begins.
		3.45	DR. D. V. DAVIES—The Osteology of the Base of the Skull.
		5.00	DR. W. FELDBERE—Vaso-Dilatory Nerve Mechanisms.
Fri.	5		D.L.O. and D.P.M. Examinations begin.
		3.45	PROF. J. D. BOYD—The Development of the Liver and Pancreas.
		5.00	PROF. R. HARE—The Source and Transmission of Nasopharyngeal Infection.
Mon.	8	3.45	DR. W. F. HARPER—The Anatomy of the Nose and Paranasal Sinuses.
		5.00	PROF. R. HARE—The Source and Transmission of Wound Infection.
Tues.	9	3.45	DR. E. L. PATTERSON—The Elbow Joint.
		5.00	DR. L. FOULDS—The Development and Limitations of Malignancy. (i) Experimental Pathology.
Wed.	10	3.45	PROF. F. WOOD JONES—The Perineum.
		5.00	DR. L. FOULDS—The Development and Limitations of Malignancy. (ii) Clinical Applications.
		7.00	Monthly Dinner for Fellows, Members and Licentiates.
Thur.	11		First Membership Examination and L.D.S. Examination begin.
		3.45	DR. G. A. HARRISON—Interpretation of Tests of Renal Efficiency.
		5.00	PROF. R. J. V. PULVERTAFT—Pathology of Polio-myelitis.
Fri.	12		D.I.H. (Part I), D.L.O. (Part II), and D.P.M. (Part II) Examinations begin.
		3.45	DR. G. A. HARRISON—So-Called Acid-Base Balance of Blood.
		5.00	PROF. W. D. NEWCOMB—Gastric Ulcer and Carcinoma.
Mon.	15	3.45	MR. D. W. C. NORTHFIELD—Intracranial Hydro-dynamics.
		5.00	PROF. A. HADDOW—Some Aspects of Carcinogenesis.
Tues.	16	3.45	PROF. C. M. WEST—The Skin.
		5.00	PROF. S. L. BAKER—The Absorption and Deposition of Bone.
Wed.	17	3.45	PROF. J. BEATTIE—Autonomic Nervous System (Central).
		5.00	PROF. J. W. S. BLACKLOCK—Surgical Tuberculosis of Bovine Origin.
Thur.	18	3.45	PROF. R. G. T. LIDDELL—The Pyramidal Nervous System.
		5.00	DR. J. HAMILTON-PATERSON — Reticulosis and Lymph gland Enlargement.
Fri.	19		D.I.H. Examination (Part II) begins.
		3.45	DR. J. D. ROBERTSON—Calcium Metabolism.
		5.00	DR. J. HAMILTON-PATERSON—Myelomata and their Relation to the Haemopoietic Bone Marrow.
Wed.	24		College Closed.
Mon.	29		College re-opens.
		5.00	MR. F. A. WILLIAMSON-NOBLE—Contact Lens.
Tues.	30	5.00	MR. A. G. CROSS—The Ocular Sequelae of Head Injuries.
Wed.	31	5.00	MR. J. D. M. CARDELL—Orthoptics in Relation to Ophthalmology.

HYPERTHYROIDISM

First Cecil Joll Lecture delivered at the Royal College of Surgeons of England
on
23rd September, 1947
by

Frank H. Lahey, M.D., F.R.C.S. (Hon.)
Department of Surgery,
The Lahey Clinic, Boston, Massachusetts

IN THE YEARS following World War I, it was my habit to visit England and the Continent about every other year to keep track of what was going on in medicine and surgery and to meet and observe those who were doing it, with the purpose of arriving at a personal estimate of the individual as well as the product of his work.

My first contact with Mr. Cecil B. Joll was of an interesting nature. I was conducted into his operating amphitheatre by another London surgeon, where Mr. Joll was doing a long list of cases of, to me, most surprising variety—from knees to necks and from stomachs to perineums. Among this long list were many thyroidectomies which I at first watched with mixed emotions.

I was distressed by what to me appeared to be the limited exposure and amazed at the shortness of the range of the operator's vision. I had never seen dissections made by the teasing technique, employing the non-toothed forceps to pull the tissues apart. With my addiction to wide exposures and knife and scissors dissection, I confess I was becoming shocked when I became aware that anatomical structures were taking form, that hæmorrhage was not occurring, and that the thyroidectomy was being efficiently completed in a very short space of time, a much shorter space of time than I, with my wide exposure, would have taken. Had I left after the first thyroidectomy, I would have been guilty of one of the greatest misjudgments of my life.

I remained until the operating list was completed, to be converted from a critic to an admirer of a brilliant technician and an extraordinarily versatile surgeon. Mr. Cecil B. Joll's contributions to our knowledge and methods in the handling of thyroid disease have been greatly respected and appreciated by everyone who is dealing with the problem of disordered thyroid states. I consider it one of the great honors of my life to be asked by the Royal College of Surgeons to give the first Joll Lecture on Thyroid Disease.

Because of the great changes which have occurred and are occurring in our knowledge of the mechanics of the production of hyperthyroidism, the physiology of the metabolism of iodine and the great advances in the

control of hyperthyroidism by the antithyroid drugs, I have selected for this address the subject of hyperthyroidism.

The thyroid gland is a simple structure unlike the more complicated organs such as the kidney, spleen, liver and adrenal gland. Its arrangement of cuboidal epithelial cells lining an acinus, able to store or discharge the material it produces, colloid and thyroxin in various stages of production and synthesis, is a very simple one. The epithelial lined acini, each representing a unit, are arranged in lobules surrounded by lymphatics and blood vessels into which it has been shown microscopically by special methods of freezing, cutting and staining devised by Dr. de Robertis[1], that droplets of thyroxin containing colloid are discharged during the excretory phase and stored during the resting stage. The whole structure is innervated by the sympathetic and parasympathetic nervous system.

If this were the complete picture of thyroid activity it would indeed be a simple one. Unfortunately, there enter into its functioning effects many more complex factors, capable of producing a great variety of effects and resulting clinical states, that is, interglandular relationships and neurohumeral influences. One has only to recall the great variety of clinical states which can be associated with hyperthyroidism to realize its complexity: the effects of emotional strain in intensifying the hyperthyroidism, the lack of a dependable relationship of the oxygen consumption to the intensity of the disease, the unpredictableness of thyroid storm or crisis following emotional upset or operative trauma, the different clinical reactions to the hyperthyroid states in the young (activated hyperthyroidism) or the occasional observation of the nonactivated type (apathetic hyperthyroidism) in older people, the effect of the disease upon personality states and emotionally unstable individuals even to severe psychotic states, the effect of increased metabolism and resulting increased circulatory rate on cardiac compensation, its effect upon growth by increasing epiphyseal closure time, the demineralization of the skeleton through excessive calcium loss and even states of true muscle atrophy. Finally, the effect of infections upon the intensity of the hyperthyroidism similar to infection affecting diabetes by decreasing the carbohydrate tolerance and increasing the insulin needs, together with many other complex effects, may be noted.

Origin of Hyperthyroidism

Although a great deal has been added to our knowledge of the possible origin of hyperthyroidism and its interglandular and neurohumeral relationships, it is by no means possible to state with any accuracy or assurance how this disease is brought about. One can only say that the thyroid is activated by the pituitary-stimulating thyrotropic hormone which arises in the anterior pituitary and that there is evidence that the pituitary gland is connected by nerve pathways to the hypothalamus. It is now known with certainty that when the thyroid hormone in the circulating blood is lowered, the thyrotropic hormone rises to stimulate

thyroid activity and the production of thyroxin. When the thyroid hormone rises, there is a lowering of the pituitary-stimulating hormone and a resulting diminution of thyroid activity as demonstrated microscopically by a resting state of the thyroid as well as by the changes in the clinical state. Following an increase in pituitary stimulation an active state of hyperplasia, increase in oxygen consumption and positive changes in the clinical state result.

Iodine Metabolism

The relationship of iodine to abnormal thyroid states, to the activity of the thyroid gland and to the production of the thyroid hormone (thyroxin) has interested those who have been dealing with the subject of hyperthyroidism for some time even at a period far antedating the discovery of iodine by Courtois[2] in 1811—the use of burnt sea sponges by the Greeks in the treatment of goitre. Historically, our knowledge of the relationship of thyroid activity to iodine metabolism is marked by the milestones of the discovery of iodine in the thyroid by Baumann[3] in 1895, the isolation of thyroxin by Kendall[4] in 1914, and the development of methods by means of which microdeterminations could be made of the very small amounts of iodine which are to be found in the circulating blood and in the thyroid itself. Further, very necessary light was thrown upon the subject of iodine metabolism when methods were developed whereby iodine could be separated into its organic and inorganic fractions. In a paper of such general character as this one, it would be impossible to set down the names of all of those who have had a part in bringing our knowledge of iodine metabolism up to the point at which it now is and, lest I be guilty of failing to mention some who have made important contributions to the subject of iodine metabolism, I will state only that investigators in your country have made contributions of the greatest importance to this subject.

Because of the inseparable relationship of iodine metabolism to hyperthyroidism, it will be of value to set down some of the fundamental facts which have been established regarding this subject.

Mr. Harold Perkin[5], the biochemist associated with the clinic, and Dr. Cattell and I some years ago demonstrated that the average blood iodine in a normal person in the Boston area was from 6 to 8 gamma per cent., and that in patients with hyperthyroidism it ranged from 21 to 100 gamma per cent.

In determining normal and abnormal blood iodine values, one must have in mind that they will vary, dependent upon the locality in which the patient lives, if it be rich or poor in iodine, whether the patient has been on a diet which is rich or poor in iodine, and whether the patient is taking any medication in which there is iodine. One will need also to have in mind that the total blood iodine determination represents both organic and inorganic iodine and that the fraction of significance in the patient with hyperthyroidism is the organic fraction.

The administration of iodine to the patient with hyperthyroidism produces not only a distinct clinical improvement but also brings about very demonstrable evidence histologically that the gland is quickly converted from a state of active discharge to one of storage (involution ; see Figs. 1 and 2). During the period of treatment with iodine (commonly, Lugol's solution) there is a prompt and remarkable rise in the total blood iodine which upon fractionization will be found to be made up largely of inorganic iodine and that the organic iodine will be found not to have risen but to have dropped as would be expected with clinical improvement. This would be assumed if there is a correlation between the clinical improvement and the diminished production or discharge of thyroxin.

In connection with blood iodine studies, it may now safely be said that if methods of determination are accurate, the patients with hyperthyroidism have an increase in the organic fraction of their blood iodine and that following relief from their hyperthyroidism by ligation of the superior thyroid arteries, subtotal thyroidectomy or by treatment of the hyperthyroidism by X-rays or radium, provided it brings about a clinical improvement and a drop in the basal metabolic rate, there will be a demonstrable lowering of the organic fraction of the blood iodine.

The question will obviously be raised of the clinical value of determinations of the organic fraction of the blood iodine in patients with borderline hyperthyroidism. While it has been shown by Elmer, Rychlik and Scheps[6] that patients with hyperthyroidism have from 0·8 to 1·4 mg. of thyroxin in their blood as compared with 0·4 to 0·5 mg. in normal persons, as based upon the estimation of the total amount of organic iodine in their blood, it must be realized that these figures were obtained in demonstrable cases of hyperthyroidism and that in borderline cases there would be no such positive and convincing elevations. When one appreciates the need to adjust normal organic blood iodine levels to levels of the iodine in different communities, to the amount of the iodine in foods (sea foods, and so forth) in addition to the time, pains and possible errors involved in carrying out the test, it seems safe to say that as an aid to our diagnostic measures it does not have value beyond those measures which we already have, such as basal metabolic rate and cholesterol determinations. As a means, however, of study of thyroid function and changes, it is of the greatest value.

Now that we have had so much experience with blood iodine studies and fractionization of the total iodine into organic and inorganic iodine, there are a number of problems which immediately present themselves. Very early in blood iodine studies made in our clinic by Perkin, Cattell and myself[5], there were some confusing results which are now, in the light of our greater knowledge, more easily explained than they were at the time they were first obtained. Early in our experience we found that an elevation of blood iodine, particularly the organic fraction, was quite constant in the patient who had had hyperthyroidism for only a reasonably

short period of time. In the patient, however, who had had hyperthyroidism over a long period of time, the blood iodine determinations were often low, normal, or even below normal. When one realizes now that with long-standing hyperthyroidism, thyroid exhaustion and myxedema can result, the apparently conflicting low organic iodine is no longer confusing.

Post-operative thyroid storm is another clinical state which has interested all of us who have dealt with patients who have severe hyperthyroidism. It has been so typical of an intensification of the disease that it seemed probable that it could be due to no other cause than rapid flooding of the organism with an excess of the thyroid hormone. This has been proven to be true by Gutzeit and Parade[7] who found elevation in the organic fraction of the blood iodine within two hours after operation. In some part it explains the diminished thyroid reactions that we have had in the last ten years when, as a preliminary step to subtotal thyroidectomy, even before the period when we have had the antithyroid drugs, all of the veins draining from the thyroid gland together with the superior thyroid artery and inferior thyroid artery were ligated before the subtotal thyroidectomy was undertaken, thus perhaps preventing this discharge of hormone. In this connection it is of interest to appreciate that determinations of organic iodine in the veins leading from the thyroid show higher values than may be found in the blood in the arteries leading to the thyroid (Breitner[8]).

The demonstration of increased amounts of thyroxin in the blood stream of patients with hyperthyroidism will be discussed later in relation to the period of time which will elapse when the patient is on full dosage of propylthiouracil before the basal metabolic rate can be dropped to normal since that period is undoubtedly related to the time it takes to use up the thyroxin already manufactured.

The studies of iodine metabolism have served to disprove the theory of dysthyroidism or the production of an abnormal thyroid secretion in primary hyperthyroidism, as proposed some years ago by Henry Plummer[9]. It seems apparent from studies of organic blood iodine that the thyroid secretion which produces hyperthyroidism is of the same character as that found in the normal thyroid, differing only in that there is an excess of it.

One of the very interesting developments as a result of the very large amount of investigative work which has been done upon blood iodine is the demonstration of the fact that by the iodination of casein, serum albumin or serum protein, a material can be produced which is capable of relieving myxedema and from which, by methods of hydrolysis, pure crystals of thyroxin can be obtained. It is of further interest in this connection to realize that in order to obtain material capable of elevating the metabolic rate, the iodination must be within proper percentage figures—approximately 7. This raises the question which has interested

all observers of thyroid disease over the years, that is, whether or not it is possible that thyroxin can be produced outside of the thyroid gland. Salter[10], in his book "The Endocrine Function of Iodine," raises the very interesting question that the hormone which passes directly into the blood stream may be quite different from the hormone which is stored in the acini of the thyroid gland.

These are but a few of the fundamental questions involved in thyroid abnormality. With the means at hand to study and experiment with the different thyroid conditions, such as the determination of oxygen consumption by thyroid slices, the study of the number and migration of the colloid droplets within the acinous cell, the changing heights of the acinous cells under varying conditions, involution and hyperplasia, the reactions to materials as tested by the Gudernatsch[11] and Uhlenhuth[12] tests and the reaction of thyroid tissues experimentally to the antithyroid agent of the thiourea group, the sulfaguanidine group and para-aminobenzoic acid, great facilities are provided for the exploration of this field, which up to within recent years has been very much beclouded. With all of the added facilities at hand for the study of thyroid function, a large number of investigators have interested themselves in this field, to which has been given added momentum by the discovery of the antithyroid agents by Mackenzie and Mackenzie[13], and Richter and Clisby[14], and their practical application by Astwood[15].

With some of the fundamental facts concerning hyperthyroidism recorded, I would like to discuss now some of the clinical experiences which we have had in doing something over 26,000 thyroid operations upon something over 23,000 patients. This large experience has given us the opportunity to observe every variety of thyroid state and over the years to change and modify our ideas and methods as it has become evident that modification was necessary with increasing knowledge, increasing discoveries and now, particularly, the discovery and employment of antithyroid agents.

Prior to the discovery of the antithyroid agents I am sure that I would have been inclined to spend some time discussing the methods and measures for diagnosing borderline states suspected of being due to hyperthyroidism. I would have been inclined to discuss also the value of the basal metabolic rate in the diagnosis of hyperthyroidism including the borderline states, and its value as a criterion of operability in relation to the danger of a surgical fatality. Since it is now possible to inhibit completely the further synthesis of thyroxin by the administration of these antithyroid agents, any elevated basal metabolism resulting from hyperthyroidism can, with adequate doses of these agents given over a sufficient length of time, be brought to normal, and the question of borderline hyperthyroidism thus as definitely settled as it would be by trial thyroidectomy.

I wish to call attention again to the clinical fact established by Boothby, Berkson and Plummer[16] that in certain individuals a normal metabolic

rate is a minus metabolism and that in such an individual a metabolic rate of plus 10 represents an elevated metabolism. Dr. Elmer C. Bartels[17] has recently reported in the Lahey Clinic Bulletin two patients with severe hyperthyroidism and normal metabolic rates, with complete relief of the hyperthyroidism by radical subtotal thyroidectomy; they are well, without myxedema and with well-marked minus metabolic rates.

The antithyroid agents of the thiourea group have so completely changed the clinical problem of hyperthyroidism that I feel sure that many of the serious problems of the past, such as the pre-operative preparation, the oxygen content of anæsthetic agents in severely toxic patients, when to do multiple stage operations, the post-operative treatment of thyroid storm and the dangers of other complicating diseases and states such as diabetes, childhood, pregnancy and serious cardiac states, no longer exist and so do not need discussion. When it can be said that for practical purposes there are no patients with hyperthyroidism who cannot, by the proper use of propylthiouracil, be converted into individuals with normal basal metabolic rates and free from hyperthyroidism, it seems evident that I should not waste time discussing those things of the past but rather use all of it in bringing to you our conclusions based upon a good-sized experience in the employment of these substances, thiouracil, thiobarbital and propylthiouracil in the preparation of patients for subtotal thyroidectomy.

The views here presented are based upon 1,000 thyroidectomies done upon 1,000 patients with hyperthyroidism prepared for operation with first thiouracil then thiobarbital and now, for the last two years, propylthiouracil. Before entering into a consideration of the many different phases of this experience it should be stated as a preliminary conclusion from this experience that by the proper use of propylthiouracil, subtotal thyroidectomy for hyperthyroidism either of the primary or secondary type, true exophthalmic goitre or toxic adenoma, has been converted *into a procedure followed by no more post-operative reaction* than occurs after an operation for the removal of a non-toxic adenoma.

Proof of this statement is the fact that 1,000 consecutive patients with hyperthyroidism prepared for surgery with thiouracil, thiobarbital or propylthiouracil have now had subtotal thyroidectomy with but one death and that a death on the second post-operative day from coronary thrombosis unrelated to the hyperthyroidism. While the mortality rate in the 25,000 thyroid operations has by various measures been kept at a low level, 0·75 per cent., it must be realized, nevertheless, that up to the advent of these agents each year since the beginning of our experience, there had been a few cases of such severe toxicity that in spite of the most careful preparation, multiple stage operations and especially post-operative care, fatalities had consistently occurred.

Before discussing the clinical application of thiouracil, thiobarbital and propylthiouracil, it will be of interest at least to discuss the possible mechanism by which these antithyroid agents inhibit the synthesis of the

thyroid hormone. We have shown in a recent article on this subject in the Annals of Surgery[18] that while the administration of these antithyroid agents will bring about a drop in the metabolic rate, a lowering in the organic fraction of blood iodine and a relief of the symptoms associated with hyperthyroidism, a microscopic section of the thyroid will still show the hyperplasia of the thyroid which is so consistently associated with hyperthyroid states (Fig. 1). I mention this particularly to make it available when mention is made later in this paper as to our opinion concerning whether these thiourea agents will serve as a substitute for subtotal thyroidectomy by bringing about permanent remission in hyperthyroidism.

If we could be more certain concerning all the stages of the synthesis of thyroxin up to its complete production as a thyroid hormone, it would be possible to state with greater accuracy how thiouracil, thiobarbital and now propylthiouracil bring about the inhibition of the further synthesis of thyroxin. When we can only be sure of the development of diiodotyrosine from potassium iodide and sodium iodide and not be sure about the further development from diiodotyrosine into thyroxin, it is obviously impossible to be completely certain about the inhibiting effect of these antithyroid agents.

If it may be assumed, as has been suggestively demonstrated by de Robertis, that the conversion of diiodotyrosine to thyroxin is due to an enzymatic process called peroxidase, it is then probable, as de Robertis[19] has demonstrated, that these antithyroid agents have the capacity to interfere with this peroxidase process. It has been suggested by others that these antithyroid agents have an effect on the inorganic iodine of such character that the thyroid is not able to utilize it in the process of synthesizing it into thyroxin.

These two diverging viewpoints at present concerning the action of thiouracil and propylthiouracil are represented by the work of de Robertis,[19] who in 1946 demonstrated that thiouracil inhibited the staining reaction of the thyroid cells for peroxidase, the same phenomenon having previously been noted by Dempsey[20] in 1944. Mackenzie,[21] in a recent paper, came to the conclusion that thiouracil exerts its antithyroid action by its chemically reducing effect upon iodine.

Regardless of how these effects are brought about, it has definitely been established that they occur with no demonstrable histologic evidence as to how they are brought about, leading to the reasonable deduction that the inhibiting effect is a result of chemical or enzymatic changes and not cellular changes.

We have further demonstrated in investigations on this subject, that while the thiourea agents are capable of inhibiting the synthesis of thyroxin, this effect does not change the capacity of the thyroid to accept iodine or its capacity to change to what has been called the thyroid involution state with cuboidal cells, dilated acini and stored colloid material (Fig. 2).

As a result of our considerable experience with this material and that of many others published in the literature, it can be concluded that these agents can, within a few days, when the tissues have been thoroughly saturated with them, prevent the further formation of thyroxin, that they do not affect the ability of iodine to involute the gland, and that they have no effect upon thyroxin already manufactured and stored in the tissues and in the thyroid.

Our experience with antithyroid agents has been limited to the three agents already mentioned, in sequence of their discovery, application and demonstration of percentage of complications associated with them.

We first began to treat patients with hyperthyroidism with thiouracil, 0·6 gm. daily, and found that this material produced complications in 9 per cent. of the cases. The most serious of these complications was agranulocytosis; the others were fever reaction and enlargement of the salivary glands of a sensitization nature, and skin changes (eruption and scleredema).

Soon after this Astwood[22] proposed the employment of thiobarbital. Twenty-eight patients were treated with this material in daily doses of 50 mg. This was found equally as effectual as thiouracil but was soon abandoned because the incidence of complications associated with it was 28 per cent., most of the complications being depression of white blood cells.

Following this, propylthiouracil was proposed by Astwood[23] and has been employed now in the present preparation of all our patients in the last two years. This is as effectual in reducing the metabolic rate as the other two antithyroid agents and has associated with it an incidence of complications of only 1·4 per cent.

It has been stated by Astwood[23] that propylthiouracil does not produce agranulocytosis, something which we, and now others, are coming to know not to be true. These agents, which are of such powerful character as to be able completely to interfere with the synthesis of thyroxin, are likewise, in certain susceptible individuals, able to depress the bone marrow to such a degree that if their administration is persisted with, there will be a complete disappearance of polymorphonuclear leukocytes. We feel safe in saying, as a result of this good-sized experience, that thiouracil and thiobarbital should be abandoned and, with one exception (noted later), replaced by propylthiouracil.

When we first began to use propylthiouracil we soon became aware of the fact that the dosage of 75 mg. was completely inadequate. This dose has now been increased to 200 mg. and in certain intractable cases, to 400 mg. given in divided doses morning and evening.

We believe that agranulocytosis and its consequences are sufficiently dangerous, if unrecognized, that these drugs should never be given without periodic (ten to fourteen days) white and differential counts. Further, we believe that once white and differential counts have started to fall as a result of the effect of propylthiouracil on bone marrow, drops to

dangerous levels can occur rapidly. For this reason we have established a drop to 4,500 white cells or a drop in the differential count to 45 per cent. polymorphonuclear cells as the level at which further administration of this agent should be stopped or its administration carefully watched.

The complications with the administration of propylthiouracil have been limited to a fever reaction in one patient and depression of white blood cells in seven patients. Agranulocytosis, in our experience, has been the only serious complication, and occurred twice. There have been a few cases in our experience in which quite severe drops in white counts and differential counts have occurred during the administration of propylthiouracil, but by proper treatment, all of these have been restored to normal levels.

We have learned, in treating the patients with agranulocytosis secondary to these drugs, that the only treatment of real value is prompt withdrawal of the drug and administration of penicillin in large doses. We have found vitamin B_6 and liver extract to be of no value. It is to be assumed as proven that the agranulocytosis, which is associated with the administration of these antithyroid agents, is the result of a depression of bone marrow. These patients can be saved only by withdrawing the agent which depresses the bone marrow and protecting the individual from infection by administering penicillin until the bone marrow has so regained its function as to be able to protect itself. Usually the blood elements return to normal after eight days.

We have learned a few other things in connection with the administration of these agents. One is that once a patient has had a reaction with any one of these antithyroid agents, he will be so sensitized to it that he will be more liable to have another reaction if the administration of the same agent is stopped and again employed. We have learned, likewise, that when a patient has had a reaction with propylthiouracil he may frequently be carried on with thiouracil without a further reaction.* While we have abandoned the use of thiobarbital we similarly learned during the time when it was employed, when one of its complications occurred, that by withdrawing thiobarbital and employing thiouracil, the patient could frequently be carried on to a complete lowering of the metabolic rate without further recurrence of the complication.

In the patients we have had under observation, while being carried on these drugs over prolonged periods of time in an attempt to bring about permanent remission of hyperthyroidism without surgical interference, we have noted that patients may go weeks or months on full doses of the antithyroid agents without complications and then agranulocytosis develop at any time up to nine months. The observation that complications can occur early or late in the administration of these antithyroid agents is important, lest the regular estimations of the white and differential counts be neglected and an avoidable fatality occur. We have observed

* Note previous exception to abandoning the use of thiouracil.

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Dr. Frank Lahey being admitted as an Honorary Fellow of the Royal College of Surgeons of England by the President, Sir Alfred Webb-Johnson, Bt.

[Facing page 286

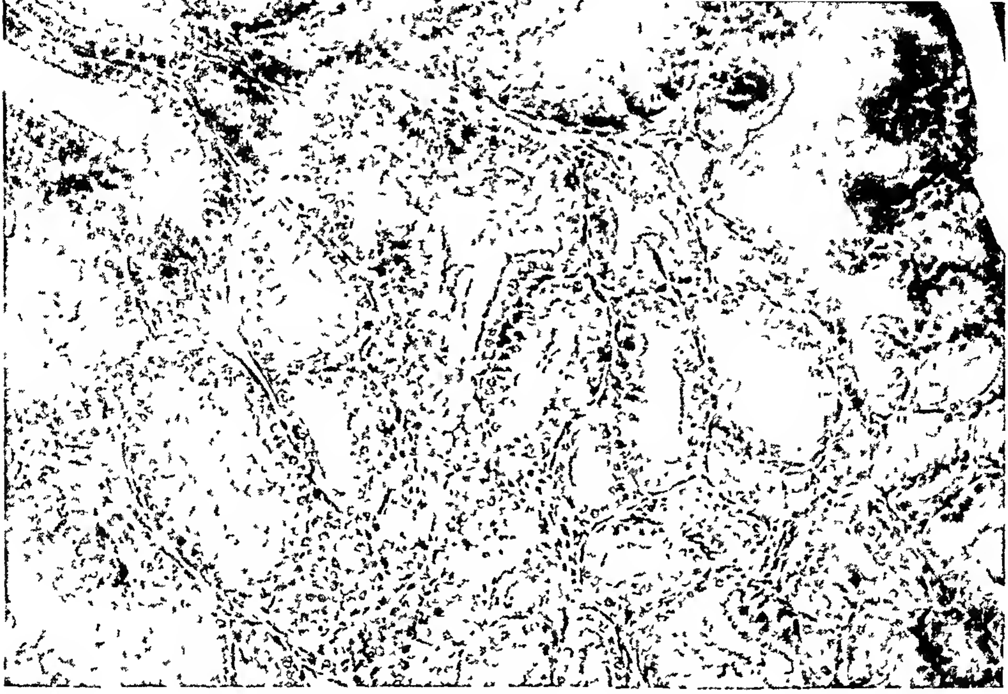

Fig. 1.

This illustration demonstrates the hyperplasia still present in the hyperdynsil patient whose metabolism is converted to normal by administration of propylthiouracil and to whom no iodine has been given. Compare this illustration with Figure 2 in which involution with iodine is demonstrated.

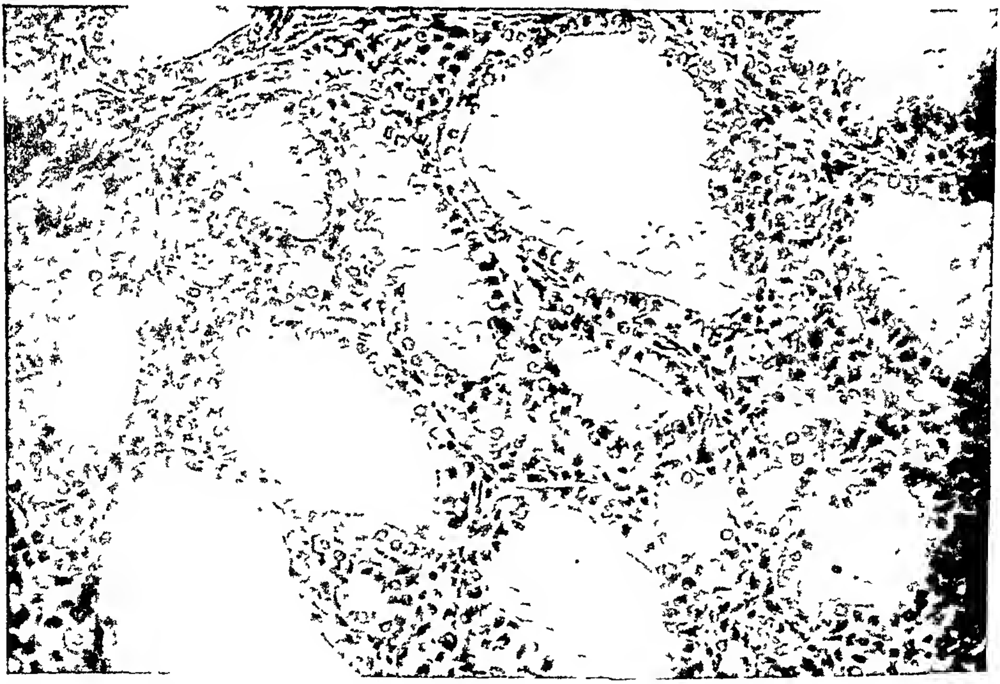

Fig 2.

This is a section of the thyroid gland of a patient whose metabolism has been brought to normal with propylthiouracil, but in whom hyperplasia, as shown in Figure 1, existed previous to the administration of iodine to produce involution in the propylthiouracil-treated patient.

also that the length of time the drug is given in an attempt to bring about a permanent remission of the hyperthyroidism has nothing to do with the reappearance of the hyperthyroidism upon its withdrawal. We have seen recurrence of hyperthyroidism after the drug has been given three months, twelve months, eighteen months, and longer. Thus, it may safely be said that the length of time the drug is given plays no part in the likelihood of bringing about a permanent remission of the disease.

When we first began to employ thiouracil solely in the preparation of patients with hyperthyroidism for subtotal thyroidectomy, impossible operating conditions were encountered. When it is realized, as stated earlier in this paper, that although thiouracil and propylthiouracil bring the metabolic rate to normal, the thyroid gland still remains in a state of hyperplasia,* then the difficulties encountered in carrying out subtotal thyroidectomies on such uninvoluted glands can immediately be appreciated. It was not until we learned to prepare these thiouracil-treated patients with Lugol's solution given during the last three weeks of the preparation with the antithyroid agents, thus bringing about thyroid involution, that satisfactory operating conditions resulted (see Fig. 2).

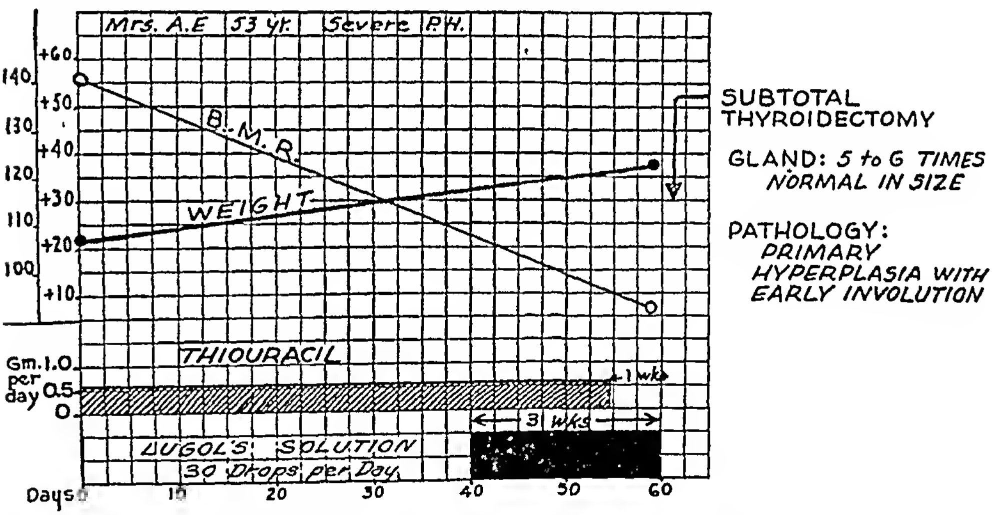

Fig. 3.

This is a typical example of our original plan to prepare patients with thiouracil and to give iodine for the last three weeks. Note in Figure 4 the change in plan by combining iodine with propylthiouracil throughout the period of administration. As was noted in the text, we now believe that the original plan, as shown in this illustration, is the more desirable of the two.

At the beginning of our experience with these drugs we advised that full doses of the antithyroid agent be employed up to the time that the metabolic rate was brought to normal, and that the antithyroid agent be omitted for one week before the date planned for the subtotal thyroidectomy. We advised that for the last three weeks before the date planned

* See Figure 1 showing hyperplasia in a patient prepared with propylthiouracil.

for the subtotal thyroidectomy, 10 minims of Lugol's solution be given daily (Fig. 3). This brought about ideal operating conditions. The antithyroid agent is omitted for one week prior to the subtotal thyroidectomy because we have learned that an agranulocytosis may appear up to one week after withdrawal of the agent, a very undesirable complication should it occur immediately following the subtotal thyroidectomy. We have found that the three-week period of administration of Lugol's solution brought about involution of the thyroid just as satisfactorily as did Lugol's solution administered to the patient with hyperthyroidism who was not receiving an antithyroid agent.

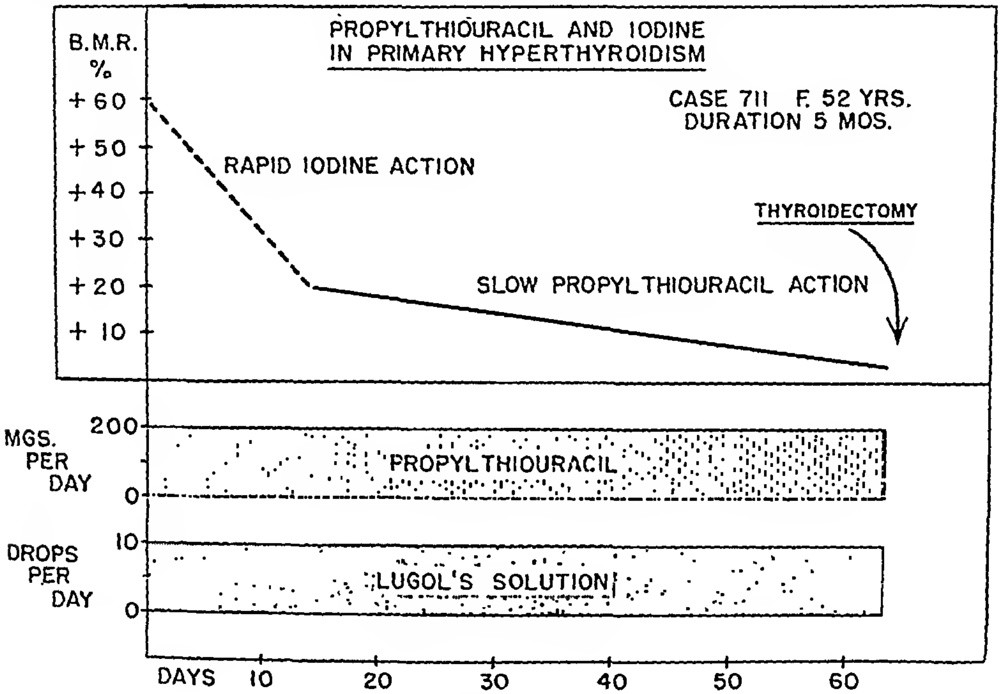

Fig. 4.
This is the plan of preparation by combining iodine with propylthiouracil from the beginning of the period of preparation and throughout it. Note the prompt effect of the iodine upon the metabolic rate and the slow propylthiouracil effect. As stated in the text, this has largely been abandoned for the plan shown in Figure 3 in which iodine is given only for the last three weeks of the period of preparation.

Because we had realized that thiouracil or propylthiouracil does not accomplish its effect upon the hyperthyroidism for several days and because we are constantly dealing with patients sent to the clinic in severe stages of hyperthyroidism* we began about a year ago the combined administration of 10 minims of Lugol's solution with 200 mg. of propylthiouracil from the first day of treatment until the patient was ready for operation, continuing the iodine but similarly omitting the propylthiouracil for the last week to avoid an unexpected complication at or

* Note in Figure 4 the early drop in metabolism when iodine is combined with propylthiouracil throughout the period of preparation.

immediately after operation (Fig. 4). This has not proven as completely satisfactory as the previous method of administering propylthiouracil alone throughout the period of the preparation, omitting it for the last week, and employing Lugol's solution only for the last three-week period, since with this new plan the time of pre-operative treatment is prolonged and in some patients with large hyperplastic glands the disease seems under this combined plan never to have become fully controlled. This may be evidence in favour of the theory of Mackenzie[21] that the thiourea agents accomplish this antithyroid action by their chemically reducing effect upon blood iodine. We have now abandoned this method of pre-operative treatment to resume the original method as shown in Figure 3, giving Lugol's solution only for the last three-week period except in patients having severe hyperthyroidism with impending crisis to whom iodine is given immediately.

The occurrence of excessive technical difficulties in patients with primary hyperthyroidism or exophthalmic goitre operated upon after being prepared solely with the antithyroid agents and without the administration of Lugol's solution, as compared with the lack of technical difficulties encountered in patients with toxic adenoma who have had their metabolic rate brought to normal with the antithyroid agents, and without the employment of Lugol's solution, is interesting in light of what we know concerning the origin of these two diseases. In primary hyperthyroidism it is known that the cellular overactivity (the hyperplasia) exists largely throughout the entire gland, while in toxic adenoma the hyperplasia will largely be found to be within the adenoma, and so such glands, not involuted with iodine, do not present the technical difficulty which one encounters when dealing with an uninvoluted thyroid gland in which hyperplasia exists throughout the entire gland.

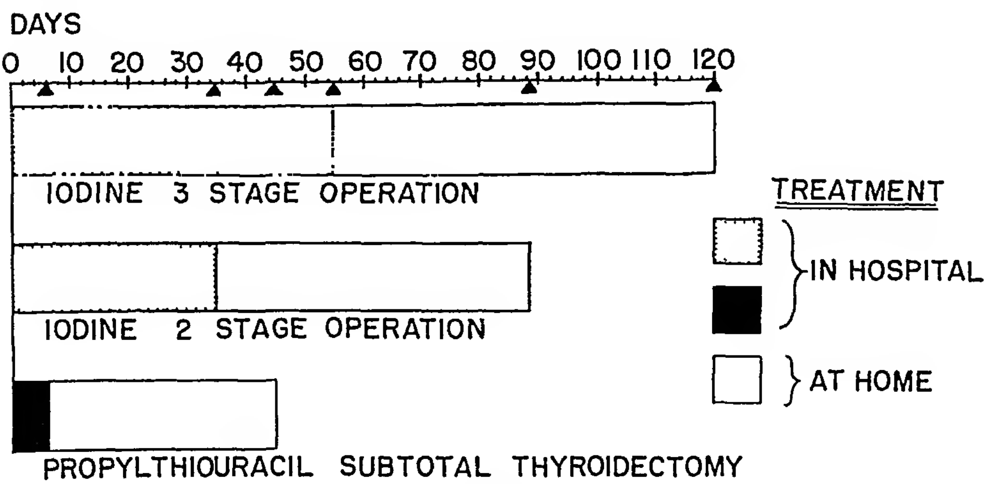

Fig. 5.

This illustration is of interest in relation to the number of hospital days saved by the patient prepared with these antithyroid agents as compared to the number of days in the hospital previous to their use.

It has been of very great interest to us, especially because of the acute shortage of beds in our country, to observe the relationship of the degree of elevation of metabolism in these patients with hyperthyroidism to the time-period required to bring the metabolism to normal while on full doses of any one of these three antithyroid agents. Although one cannot with certainty make positive statements, it can be said with relative assurance that patients with primary hyperthyroidism or exophthalmic goitre when put on these antithyroid drugs will have a drop in the metabolic rate at the rate of about one degree per day. For example, in a patient with a metabolism of +49, one can with relative safety engage a bed for such a patient seven weeks from the time of beginning the treatment and expect that at that time the metabolic rate will be normal, the patient free from symptoms and as a result of the last three-week period of administration of Lugol's solution, the thyroid gland so well involuted as to present ideal operating conditions.

In a patient with toxic adenoma we have learned that there will be an approximate average drop of 0·5 degree of metabolism per day. For example, in a patient having a toxic adenomatous goitre with a metabolism of +40 it will require approximately eighty days to get the metabolic rate to normal, and in such a patient the administration of Lugol's solution will not be necessary.

There will be exceptions to the above statement but in general it will prove quite dependable. We have had occasional patients with large toxic adenomas who have required long periods of time and doses of propylthiouracil up to 300 mg. a day before their metabolic rate could be brought to normal. The longest period of time in a patient with a large toxic adenomatous goitre which has been required to bring the metabolism to normal has been 180 days. We believe it is possible to say from our experience that the basal metabolic rate can eventually be brought to normal in all patients if adequate doses of these antithyroid agents are given over an adequate period of time.

One can reasonably explain the above time-period effects as follows. Since it is true that the antithyroid agents inhibit the further synthesis of thyroxin but have no effect upon the thyroid hormone already saturating the tissues and stored within the glands, and since it is true that the average consumption of thyroxin is in the neighbourhood of 0·4 mg. per day, then the length of time intervening between the interruption of the synthesis of thyroxin and return of the metabolic rate to normal will be related to the daily amount of the agent used and the amount of thyroxin already manufactured and in storage in the thyroid and saturating the tissues. In this connection it is to be realised that patients with the small hyperplastic thyroid glands associated with primary hyperthyroidism have in storage less manufactured thyroxin, while in the large toxic adenomatous goitres there are large amounts of colloid material in which is stored the large thyroxin reserve.

During this experience with antithyroid agents in the preparation of these 1,000 patients with varying degrees and types of hyperthyroidism for subtotal thyroidectomy, we have made and corrected a number of mistakes. We would strongly urge that since these antithyroid agents during the period of preparation for operation are to be taken at home with the family doctor or medical adviser sending reports of the white and differential counts done every ten to fourteen days, there is nothing to be gained and everything to be lost by operating upon these patients before their metabolic rate has been brought completely to normal. Early in our experience with these drugs, because many of these patients had come long distances, the operation was occasionally done when the metabolism had dropped very materially and the clinical conditions had very materially improved but had not reached normal levels. Operations were done in these few cases because it would have been inconvenient for these patients to return home, then return again to the clinic. This was an unwise position. We have learned that unless the patient is completely relieved of his hyperthyroidism, the degree of post-operative thyroid reaction is unpredictable. None of these patients has died, but a few have had reactions of such a serious character as to disturb us. Now that we know that with persistence with the antithyroid drugs, all toxicity could have been abolished and the metabolism brought completely to normal, we have taken the position that no patient is to have a subtotal thyroidectomy if the metabolism has not completely returned to normal, and patients with elevated basal metabolic rates are sent home for further treatment.

A less serious complication is in the other direction as relates to the basal metabolism. There will be some patients in whom the metabolism will drop more rapidly than is predicted and minus degrees of metabolism will be reached and the patient present definite symptoms of myxedema. In any patient in whom obvious clinical symptoms of myxedema appear, we believe it is wiser to stop the administration of the agent and wait for the metabolism to return to normal than to do the subtotal thyroidectomy during the period when they are myxedematous. The reason for this is largely that if patient's are myxedematous the incidence of post-operative respiratory difficulties will be slightly greater and there will be occasional cases in which a tracheotomy will be necessary. It is to be recalled, also, that if these patients are submitted to subtotal thyroidectomy while in a state of myxedema, one must be extremely careful about the administration of morphine. Those who have dealt with large numbers of patients with thyroid states are well aware of the insensitivity of the patient with hyperthyroidism to morphine and the increased sensitivity of the patient with myxedema to it. The combination of the thickening of the cords associated with myxedema and a depressed respiratory rate together with the edema of the larynx and tracheal mucus occurring in varying degrees following most subtotal thyroidectomies, may produce such difficulty

with breathing as to necessitate a tracheotomy which would not have been necessary in a non-myxedematous patient.

In the use of these three antithyroid agents, thiouracil, thiobarbital and propylthiouracil, in these 1,000 patients prepared with these agents and submitted to subtotal thyroidectomy, there has been a number of patients with complications such as hyperthyroidism in children, in pregnant women, in psychotic patients, in patients with idiopathic thrombocytopenia, in patients with diabetes, and in patients with various degrees of cardiac damage and decompensation.

Patients with all of these complications have been dealt with and successfully prepared for surgery with these antithyroid agents. Pregnancy has been a not uncommon one. There have been conflicting statements concerning the dangers of employment of antithyroid agents in hyperthyroid patients during pregnancy. We have prepared with full doses of these agents and operated upon patients in various trimesters of pregnancy and have seen no unfavourable result either in the mother or later in the baby. It is, however, desirable to make the diagnosis of hyperthyroidism in pregnant women as early as possible, to prepare them as promptly as possible and to operate upon them immediately in order that their metabolic rate may be restored to normal early in the pregnancy so that the pregnancy may be completed as uneventfully as possible.

The problem of the treatment of hyperthyroidism in children has in the past been a difficult one. Hyperthyroidism in children is the same disease as in adults but tends to be a little more serious. Children can be prepared with equal success with propylthiouracil and with no more hazard than in adults. The same dosage as is given to adults may be given to children, the same precautions must be taken and approximately the same period of time will be required as in adults.

Before the advent of these antithyroid agents, one of the most difficult problems with which we have had to deal was the patient with hyperthyroidism who had become psychotic. These patients would not be accepted in general hospitals, and it was difficult to find satisfactory places into which to put them for their pre-operative preparation, their subtotal thyroidectomy and their immediate post-operative care since the most ideal surgical facilities were often not available in institutions devoted solely to the care of psychotic patients. This problem has now largely been solved by the preliminary employment of the antithyroid agents upon these patients while in institutions devoted to the management of psychotics, or at home with special nurses. When the metabolism is brought to normal, there usually is a remission of the psychotic state when it has been promoted by the hyperthyroidism, during which time the patient may be placed in a general hospital, the subtotal thyroidectomy completed and the restored normal mental state maintained. Three to four months of maintenance treatment in the psychotic patient is advisable after a normal metabolic rate is reached before thyroidectomy is carried out.

The oceurrenee of idiopathic thrombocytopenia in a patient with hyperthyroidism is a rare eomplication but has oeeasionally been found in our cxperienee. In the past this was an extremely perplexing situation since operation directed toward the thyroid gland would result in teehnieal complications of a serious nature while a spleneetomy as a means of caring for the thromboeytopenia would have promoted a thyroid storm of serious and usually fatal proportions. It has now been possible with these antithyroid agents to abolish the hyperthyroidism temporarily, to do the spleneetomy and then follow it with the subtotal thyroidectomy to bring about permanent remission from the hyperthyroid state.

Because of our association at the New England Deaeoness Hospital with Dr. Elliott P. Joslin,[24] we have always had a large number of patients with hyperthyroidism and diabetes. From 1935 to 1946 there were 161 patients with hyperthyroidism and diabetes. In a reeent review of 600 conseeutive eases of hyperthyroidism 25 were found to have hyperthyroidism and diabetes. At the beginning of our experienee, the mortality of hyperthyroid patients with this complication was higher than in patients without it. With the antithyroid agents, however, the metabolism is now brought to normal in all diabetic patients prior to operation, and this problem has now reduced itself solely to the management of the diabetes immediately following the operation, no longer a serious one.

In 1922, Dr. Burton E. Hamilton[25] and I began operating upon patients with severe hyperthyroidism and serious heart disease, such as serious cardiac decompensation brought about by the burden of the inereased cireulation rate assoeiated with the hyperthyroidism in patients with a limited cardiae reserve.

We applied to this group of eases the title " thyrocardiaes " and have now operated upon nearly 1,000 such individuals. The mortality in this group prior to the employment of propylthiouracil or thiouraeil while high has in the light of the seriousness of this complieation been surprisingly satisfactory (6 per cent.). Since these agents have been available, it has now been possible by their administration to lower the metabolic rate, which decreases the circulation rate, which in turn restores the compensation pre-operatively. There is an extremely important point to recall in connection with the preparation for surgery with these antithyroid agents of the thyrocardiacs with decompensation or even auricular fibrillation. It is desirable in patients with hyperthyroidism who have had either cardiac decompensation or auricular fibrillation, not only to bring the metabolism to normal but to defer operation until the metabolism has been retained at normal for one to two months by a modified dose of the antithyroid agent. It is desirable to defer operation for this period of time with the restoration of compensation, until the greatest possible degree of cardiac reserve has been built up to aid in sustaining the heart during and immediately after the subtotal thyroidectomy.

I would like to discuss now an aspect of these antithyroid agents about which there has been debate, confusion and even conflict; and that is as to whether these antithyroid agents will bring about a permanent remission from the hyperthyroidism, and serve as a satisfactory substitute for surgery. From the very beginning of the use of these drugs it has been our opinion that this would not be true. This position has been substantiated by our own experience in endeavouring to bring about permanent remissions and is further substantiated by the gradually changing opinion of those, particularly in Boston, who have been enthusiastic advocates of antithyroid drugs as substitutes for surgery.

It is difficult for one who has treated the large number of patients with hyperthyroidism by subtotal thyroidectomy that we have, to disagree as to the soundness of the employment of antithyroid agents as a substitute for surgery, without being suspected of prejudice. For that reason, it becomes necessary, I believe, for me to submit my reasons for opposing these agents as a total substitute for surgery.

It is probably true that these antithyroid agents have no effect on the hypothalamus, the emotional centre at which probably originate the impulses that incite the hyperthyroidism, that they have little if any effect upon the anterior portion of the pituitary where the stimulating hormones originate. It can be demonstrated microscopically that although the metabolism be brought to normal, these agents have no effect upon the hyperplasia within the thyroid itself (Fig. 1) and bring about their results solely in an iodine-reducing way or by interfering with the enzymatic processes within the acinar cells which presumably convert the diiodotyrosine into thyroxin. We are further sustained in our opinion that exclusive of a few patients with hyperthyroidism with small glands or small recurrent remnants who have had the disease but a short time, too high a percentage of our group of cases has shown almost immediate recurrence of the hyperthyroidism on omitting the antithyroid agent. The large and increasing number of patients coming to the clinic for subtotal thyroidectomy who have been treated elsewhere with these agents and have had recurrence adds further conviction to the opinion which we originally took on this matter.

We feel sure that there is now very much less certainty than previously in the minds of the clinicians in Boston who were its most enthusiastic advocates as a complete method of treating hyperthyroidism. A positive statement can now be made to the effect that so many recurrences take place in male patients that it should not even be tried in them.

It is my opinion that when one realizes that with the prolonged administration of propylthiouracil there will be the ever present danger of agranulocytosis, one must constantly be able to carry out periodic reliable white and differential counts, the patient must be where prompt and heroic measures are immediately available should agranulocytosis appear and if the incidence of recurrence of the hyperthyroidism is high as we from our experience know and believe it to be, surgery with its

now demonstrated almost absent mortality rate, and its slow incidence of complications in the hands of experienced men, is by all means the wisest and most satisfactory method of treating hyperthyroidism in patients prepared for it with the antithyroid agent.

One must not fail to realize in connection with the selection of a method of treatment for hyperthyroidism that not only in toxic adenomatous goitre are discovered occasional cases of malignant disease within the adenoma, but that this is likewise true in the occasional patient upon whom subtotal thyroidectomy has been carried out for primary hyperthyroidism. There have been four patients in the last four years in whom pathologic reports of frank malignant disease of the thyroid have been returned in thyroid lobes removed in patients with exophthalmic goitre or primary hyperthyroidism.

As relates to the technical procedure of subtotal thyroidectomy itself, since articles which we have written and illustrated on this subject[26] are available to everyone, it seems to me that I should not spend too much time on this aspect of the subject except to mention a few of the important points and stress their relationship to the satisfactory results in this operation.

As stated in the opening paragraph of this paper, we are addicted to long incisions and obtain wide exposures by severing and resuturing the prethyroid muscle. We have severed the prethyroid muscles and resutured them in thousands of cases. They are always severed high above their innervation close to the insertion of the sternohyoid muscle into the hyoid bone. If this is done, there will be no disfigurement or dysfunction and there will be more adequate exposure than can be obtained in any other way. I do not mean to say that excellent exposures and excellent subtotal thyroidectomies cannot be done without severing the prethyroid muscles, but better anatomical demonstration of the important structures associated with the thyroid and more certain preservation of them can be accomplished with these wide exposures than without them.

Anæsthesia has always played an important part in the execution of a thyroid operation in patients with toxic goitre because of the increased need for oxygen in these patients. A normal individual requires about 250 cc. of oxygen per minute while a patient with hyperthyroidism may require up to 800 to 1,000 cc. per minute.

Early in our experience we were enthusiastic advocates of the employment of cyclopropane as an anæsthetic agent in these cases. We were particularly interested in the employment of cyclopropane in patients with hyperthyroidism because of its high oxygen content, 70 to 80 per cent., as compared with 9 per cent. with nitrous oxide and around 15 per cent. with ethylene. With greater experience with this anæsthetic agent we have become impressed with the danger of the production of ventricular

fibrillation with its use, and have had two table fatalities with it. The capacity of this anæsthetic agent to produce cardiac fatalities from ventricular fibrillation as a result of its administration in high concentrations in the presence of other cardiac irritants such as epinephrine or thyroxin is now well known clinically and can be demonstrated experimentally in animals. For that reason, we have now abandoned the use of cyclopropane even in the patients with hyperthyroidism who have been made non-toxic with these antithyroid agents, and have induced anæsthesia with ethylene, nitrous oxide or pentothal, none of which possesses this hazard, and then continued the anæsthesia with ether.

Our views and habits of finding and demonstrating the recurrent laryngeal nerve in every patient operated upon for any type of thyroid disease, about which I have repeatedly written, are likewise too well known to require further mention.[27] I wish only again to call to the attention of those who are not constantly operating upon patients for thyroid disease, the occasional anomalies of the recurrent laryngeal nerve. I refer to the recurrent laryngeal nerves that do not descend into the thorax but pass from the vagus under the fibres of the inferior constrictor muscle at the level of the horn of the thyroid cartilage directly into the larynx to innervate the vocal cords, and also to those anomalous nerves that descend as far as the inferior thyroid artery to pass under it and upward to enter. the larynx. I wish to remind you also of the not infrequent extralaryngeal division of the recurrent laryngeal nerves into adductor and abductor fibres, injury to which, particularly to the abductor fibres, can bring about immediate and serious respiratory difficulty owing to the inability of the cords to be abducted. It is my conviction that all who are interested in thyroid surgery should acquire experience with finding and demonstrating recurrent laryngeal nerves in all patients operated upon for thyroid disease. It is not a difficult procedure. To know where the nerve is at all times permits not only its safe preservation but more certain preservation of the parathyroids and more radical removals of thyroid tissue, and has resulted in the reduction of our percentage of persisting hyperthyroidism from 7 per cent. ten years ago to under 1 per cent. at the present time. The nerve is in no way a delicate one, may be handled with reasonable impunity, and its demonstration and manipulation in several thousand cases has not resulted in any undesirable voice or breathing complications.

Tetany is one of the really serious complications of thyroid surgery. It produces symptoms which are distressing, its treatment is troublesome and expensive and for this reason we have now for several years insisted in every patient who is operated upon for thyroid disease that at least one normal parathyroid be demonstrated as intact and well vascularized on each lobe of the thyroid. This, again, is not a difficult technical procedure, it can be learned without great effort and one can soon tell what is a true parathyroid, what is a lymph node and what is a small ball

of thymic tissue. Such a technical precaution will pay high dividends in preventing one of the most undesirable complications of subtotal thyroidectomy.

CONCLUSIONS

Mr. Joll was a busy general surgeon, with a sub-interest in thyroid disease and its treatment. My own interest in thyroid disease has not been unlike that of Mr. Joll. In this lecture I have attempted to present some of the facts, many of which are as yet not too soundly established, concerning how the thyroid functions, its relationship to iodine metabolism and its relationship to the anterior pituitary and possibly the hypothalamus.

I have discussed only a few of the technical problems of the management of hyperthyroidism, such as anæsthesia, exposure and the preservation of the recurrent laryngeal nerves and the parathyroid bodies because I feel that the surgery of hyperthyroidism in your country, in my country and pretty much all over the world has become quite satisfactorily standardized and in no small part from the work and writings of Mr. Joll.

I have devoted a large part of this lecture to discussing our views and experiences with the recently developed antithyroid agents, particularly propylthiouracil. I have done this because these drugs have changed immeasurably the entire problem of dealing with patients who have hyperthyroidism, also because you have employed other antithyroid agents in your country and because it seemed valuable to put before you our experiences and conclusions from this relatively large series of cases in which they have been used in the last four years in order for you to have them for comparison with your own.

As a final note, in addition to thanking you for honouring me with the opportunity to present the first Joll Lecture, I would like to say that during this four-year period of experience with thiouracil and propylthiouracil, we have several times changed our minds and positions about how these drugs should be used in patients with hyperthyroidism.

Four years is all too brief a period of time in which to completely fix the methods of management of patients with hyperthyroidism with these agents, and in the next four years we will probably change and modify some of the views presented here. We are, I hope and believe, only on the borders of a sounder and more complete knowledge of normal and abnormal functioning of the thyroid gland and the management of its diseased states.

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THE PROBLEMS OF PORTAL HYPERTENSION

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by

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THE SURGICAL PROBLEMS posed by obstruction to the flow of blood in the portal system fall into three groups :—

(1) *Hæmorrhage.*—Hæmorrhage usually presents as hæmatemesis, the source of the blood being a ruptured œsophageal varix. Occasionally the bleeding may be gastric or duodenal, and then it may be from multiple points in the congested mucosa, or, rarely, from a large venous radicle in the wall of the stomach, usually in the pyloric antrum where the dilated gastric veins may sometimes assume an angiomatous appearance.

(2) *Intestinal Obstruction.*—This complication follows the spread of thrombosis from the portal vein to its tributaries, the pathological end-result being a venous infarction of the gut. The possibility of the establishment of a collateral circulation in the vascular supply of the bowel is greater on the venous than on the arterial side, and in addition the retroperitoneal veins connected with the bare areas of the colon may help to provide alternative channels.

(3) *Ascites.*—The presence of fluid in the peritoneal cavity may, by its very quantity, demand intervention to relieve mechanical symptoms, and it is said that the pressure of the fluid may cause or spread thrombosis in the portal vein and its tributaries. The repeated removal of large quantities of fluid rich in protein sooner or later produces a state of imbalance in nitrogen metabolism, which may contribute to a fatal termination of the disease, and which increases the operative risk of any surgical intervention.

Pathology of Portal Obstruction

There are two possible anatomical sites at which the flow of blood in the portal system may be obstructed :—

(1) *Intrahepatic Block.*—This is the site of obstruction in hepatic cirrhosis. The branches of the portal vein, from the largest to the smallest,

sooner or later show organic changes. These are of two distinct types: (*a*) hypertrophy of the scanty muscle in the medial coat of the vein, a general appearance reminiscent of the "work-hypertrophy" which characterises the arterioles in essential arterial hypertension; and (*b*) sclerotic changes, which vary in degree and situation from intimal thickening to calcification and obliteration of the lumen.

(2) *Extrahepatic Block.*—In this group the obstruction occurs in the portal vein or in one or more of its radicles. The obstruction is often primarily thrombotic in nature, and the etiology of the thrombosis may be any one of the numerous common causes, or a rare cause, of either general or local thrombosis; a distinct type is that arising as a result of failure of the normal obliterative process occurring at birth to be limited to the umbilical vein. The obstruction may also be due to partial occlusion of the portal vein by the pressure of a mass in its vicinity, the occlusion becoming complete when thrombosis occurs at the site of compression. A rare cause of portal obstruction is so-called *cavernomatous formation* in the porta hepatis. Some believe that the microscopic appearances in this condition merely indicate a stage in a natural attempt to recanalize the portal vein; others hold that the condition is a true angiomatous malformation, because the lesion may involve not only the portal vein itself, but also the structures in its neighbourhood—for example, the gastrohepatic omentum.

Whatever its site, the presence of obstruction in the portal venous system upsets the balance of the pressures in the systemic, portal and hepatic veins, and perhaps in the tributaries of the portal vein. The accepted pressures for these are: systemic veins, ±140mm. water; portal vein, ±65mm. water, and hepatic veins, 0-10mm. water. In portal obstruction, pressures as high as 500mm. of water have been recorded in the portal system; the highest pressure I have encountered was 320mm. water, measured in a tributary of the splenic vein.

In order to compensate for the portal obstruction, a copious collateral venous circulation develops, and the nature of this differs according to the anatomical site of the obstruction.

(1) When the obstruction is intrahepatic, the current of blood in the collateral veins is *hepatofugal*, to provide drainage for the portal radicles to the systemic system. Macindoe has described three main sites where venous collaterals are numerous:—

(*a*) Where the alimentary tract begins and ceases to have absorptive and secreting functions—at the cardia and at the anus.

(*b*) The para-umbilical veins associated with the obliterated foetal circulation, and

(*c*) Retroperitoneal veins, communicating with the viscera (colon, liver, duodenum) where they lack a peritoneal covering.

(*d*) In addition, there may be a further by-pass, apposite to the operative procedure to be discussed, through which a certain amount of portal blood may be shunted to the left renal vein. Various possibilities have been described, of which I have ençountered the first and third :—

(i) Splenic vein to left renal vein.

(ii) Splenic veins to diaphragmatic veins to left adrenal vein to left renal vein.

(iii) Splenic vein to pancreatic veins to left renal vein.

(iv) Gastric veins to splenic vein to left adrenal vein to left renal vein.

(2) When the obstruction is extrahepatic, the direction of blood flow in the collateral veins is *hepatopetal*, in an attempt to by-pass the obstruction and to bring blood back into the portal vein, or into one of its main branches, usually the left. These " accessory veins " were described by Sappey. It is obvious that the groups which will develop as collaterals will vary according to the site of the block, and that to Sappey's list must be added the group described under (1) (*d*) (iv) (which have been noticed since Sappey's day), and which differ from his " accessory veins " in that the flow of blood in them is hepatofugal :—

(*a*) Cystic veins, 15-20 in number, which penetrate the liver from the hepatic surface of the gall-bladder.

(*b*) Omental veins.

(*c*) Unnamed veins in the hilum of the liver.

(*d*) Venæ comitantes of the portal vein and hepatic artery.

(*e*) Diaphragmatic veins.

(*f*) Veins in the suspensory ligament of the liver.

(*g*) Para-umbilical veins, and

(*h*) Channels in the portal cavernomatous tissue.

Irrespective of the anatomical site of the obstruction, a collateral venous circulation requires time for its development. The clinical progress of cases of portal obstruction therefore fall—although without any sharp demarcation—into three groups :—

(1) An *acute* group, in which the obstruction is rapidly produced, or widespread, in which there is no time for the development of an adequate

collateral circulation, and the condition terminates fatally after a short illness. In this group the question of surgical treatment does not arise.

(2) An *episodic* group, in which the obstruction is less rapidly produced, or less complete. Symptoms and signs abate as the collateral circulation takes over the venous load, and there may be long intervals, measured even in years, before an increase in portal obstruction surprises an inadequate collateral circulation, and symptoms recur.

Thus in one of my cases of splenic thrombosis, there were episodes of hæmatemesis in infancy, at five years of age, at eight years and at 16 years.

In this group the decision to advise surgical interference is one demanding most careful appraisal of the whole clinical picture.

(3) A *chronic* group, in which the initial symptoms and signs may have to be tided over by one or more tappings of the abdomen, or transfusions of blood, after which a sufficient collateral circulation develops to maintain a reasonable equilibrium. This development may substitute one pathological feature for another: that is, the ascites may be dealt with at the cost of œsophageal varices. Thus in a man of 27, the first feature requiring treatment was ascites, which did not recur after paracentesis. Four months later there were two episodes of severe hæmatemesis. When a lieno-renal anastomosis was made, two months after the last hæmatemesis, there was no free fluid in the peritoneal cavity.

Many of the cases in this group are progressive, however slowly, and operation appears to provide a useful immediate form of treatment, and possibly some insurance against too rapid deterioration in the condition of the patient.

Choice of Cases for Surgical Treatment

Whether the obstruction be to the venous drainage of the whole portal system, or to that of the spleen alone, usually the patient will have an enlarged spleen, and will thus, in the first instance, naturally come under the care of a physician interested in hæmatology. It is well that this should be so, for the first special investigation required is a complete study of the blood-picture. For the last 15 years, in Aberdeen and in Edinburgh, I have had the good fortune to collaborate with Professor L. S. P. Davidson in the management of such cases, and from him I have learned at least the rudiments of hæmatology; I believe it to be essential that any surgeon who operates on such cases should have this background of knowledge. The examination should, of course, exclude other causes of hæmatemesis and of ascites; the radiologist usually, but not always, will be able to demonstrate œsophageal varices when they are the source of the hæmorrhage. An estimate of hepatic function—so far as this is possible—should be made, and this will include such tests as the determination of the values in the blood for serum bilirubin, alkaline

phosphatase, urea nitrogen, and the serum proteins, a laevulose tolerance test, and the bromsulphonephthalein test. Biopsy of the liver by puncture may give positive information, but in two cases, and on two occasions in one of these, the biopsy material showed normal liver tissue although at the subsequent operations cirrhotic changes were obvious. Naturally, an essential preliminary, if lieno-renal anastomosis is a possibility, is to ascertain, by intravenous pyelography, that both kidneys are present, that they are normal anatomically (for instance, not horse-shoe or sacral in type) and that the right kidney shows normal function.

Choice of Operation

(1) *Venous Infarction of the Intestine.*—This complication provides an emergency, identified by the features of intestinal obstruction with bloody stools. Since there is a possibility that collateral venous channels may restore adequate venous return, I believe that if the diagnosis is made early enough, the patient should at once be brought under the influence of heparin, and that enterectomy should be reserved for cases which do not show early and substantial improvement under this treatment.

(2) *Hæmorrhage, with or without Ascites.*—If ascites is present, portal obstruction is certain; if it is absent, the block *may* be limited to the splenic vein, but not necessarily so. Several procedures have been employed:—

(*a*) *Splenectomy.*—The advocates of splenectomy hold that the operation diminishes portal pressure by reducing the amount of blood destined for the portal vein. Professor Davidson and I do not feel that, except in cases of thrombosis of the splenic vein to which I shall return, the results of splenectomy are any better than those of conservative measures, when a series of cases is reviewed over a sufficiently long period.

(*b*) *Injection of Sclerosing Solution into the Œsophageal Varices.*—This procedure may deal with a local lesion in the œsophagus; but it is fundamentally unsound, because it does nothing to diminish portal pressure. It may be compared to the lack of success attending the injection of varicose veins of the leg, when an incompetent internal saphenous vein is not first dealt with by high ligation.

(*c*) *Ligation of the Coronary Vein of the Stomach.*—This vein is accessible for ligation during its course from the lesser curvature of the stomach to the posterior wall of the lesser peritoneal sac. It is fundamentally unsound, since it is based on the hypothesis that the increased pressure is from the portal side only, whereas the swollen veins accompanying the vasa brevia are also contributory. In cases of splenic thrombosis it would be positively dangerous, for it would raise the pressure in the already dilated œsophageal varices.

(*d*) *The Talma-Morison Operation and its Variants.*—These procedures are designed to promote the formation of adhesions between the viscera and the abdominal walls, in which, it is hoped, venous channels will develop: in other words, to hasten and possibly to increase the usual pathological reaction to the occurrence of portal obstruction. Undoubtedly they are sometimes effective: either in cases in which, in any event, equilibrium would have been established, or by providing just enough additional circulation to secure equilibrium.

(*e*) *Laparotomy, Determination of Site of Block, followed by either Splenectomy, or Venous Shunt.*—In the majority of cases the procedure (if any) to be carried out can be determined only by a study of the local conditions disclosed by laparotomy. This study may include :—

(i) Inspection of the liver, to determine the presence or absence of cirrhosis: cirrhosis is absent when the block is limited to the splenic vein.

(ii) An examination of the disposition of the venous collaterals: it may be possible to determine whether they are attempting to by-pass a portal block, or whether they are assisting to drain the spleen alone (vasa brevia, diaphragmatic veins, pancreatic veins).

(iii) An estimation of the pressure in the two main tributaries of the portal vein, the superior mesenteric and splenic veins: a normal pressure in the superior mesenteric, with a raised pressure in the splenic, points to splenic vein thrombosis; if a raised pressure is found in both veins, the block is in the portal vein. These pressures are measured by a manometer containing sterile 3·8 per cent. sodium citrate solution, zero being adjusted to the level of the portal vein.

(iv) A demonstration of the site of the block by venography, the medium (50 per cent. Perabrodil) being injected into the splenic vein or into one of its main branches.

Operative Technique

(1) *Splenic Thrombosis.*—If the site of obstruction is in the splenic vein, splenectomy is indicated. The branches of the splenic artery and vein should be secured as near to the hilum as is possible, to avoid the numerous small veins passing into the pancreas from the splenic trunks. The veins at the upper pole, accompanying the vasa brevia, should also be ligatured close to the spleen, to avoid their communications with the diaphragmatic and œsophageal veins, the engorgement of which has produced œsophageal varices and led to the hæmatemesis.

(2) *Portal Obstruction.*—When the portal vein is occluded, there is a choice of two procedures :—

(*a*) *Portocaval Shunt.*—For many years occasional attempts have been made to produce a portocaval shunt by the construction of an Eck fistula.

I made such an attempt in 1940, the fistula being established by the method of the cutting-out silk suture, used in animals. The patient died on the sixth day, of bronchopneumonia, and at autopsy the orifice of the fistula was found to have been occluded by antemortem clot.

With the publication of the papers by Whipple and by Blakemore and Lord, the technique has been much simplified. The portal vein is displayed and divided, the proximal end being ligatured, the distal threaded over a vitallium cannula of suitable size. Two concentric purse-string sutures of silk are then placed in the medial wall of the vena cava, and a cruciate incision made within the innermost. Through this incision the vitallium tube carrying the portal vein is inserted and held in position by tightening the purse-string sutures in turn, from without inwards, so that they lie above the retaining flange on the cannula. I have no personal experience of this operation. It provides a complete shunt, and would appear to be indicated when ascites is prominent.

TABLE 1

CASES OF OBSTRUCTION IN PORTAL SYSTEM SHOWING RESULTS TO DATE

No.	Sex and Age	Presenting Feature(s)	Duration of Illness (Months)	Operation	Result
1	Male 26	Hæmatemesis Ascites	18	Eck fistula	*Died* 6th day, bronchopneumonia
2	Male 15	Hæmatemesis	12	Spleno-renal anastomosis	After 15 months, *improved.* One episode melaena
3	Female 27	Hæmatemesis	48	Spleno-renal anastomosis	After 10 months, *improved.* One episode melaena
4	Female 46	Hæmatemesis	36	Spleno-renal anastomosis	After 8 months, *improved.* No further hæmatemesis
5	Male 27	Hæmatemesis	18	Spleno-renal anastomosis	Operation September 1947
6	Female 54	Hæmatemesis	24	Splenectomy	After 26 days, *died.* Clinically hepatic failure
7	Female 16	Hæmatemesis	122	Splenectomy	After 10 months, *improved.* No further hæmatemesis
8	Female 6	Hæmatemesis	24	Splenectomy	After 6 months, *improved.* No further hæmatemesis

(*b*) *Spleno-renal Anastomosis.*—This operation is also a product of the ingenuity of Whipple and his school. The anastomosis is established by removing the spleen and left kidney, threading the splenic vein over a vitallium cannula of appropriate size, and inserting the cannula into the open end of the stump of the renal vein, where it is secured by two silk ligatures; alternatively, the veins may be united by end-to-end anastomosis; or the splenic vein may be joined end-to-side to the renal vein, without sacrificing the left kidney, as preferred by Blalock and Milnes Walker.

I have had experience of the first two of these in the four cases in which I have employed the plan. The operation is a long one on account of the number of veins which must be secured, and I have not succeeded in completing it in less than two and a quarter hours. Good anæsthesia, and good teamwork between the operator, assistants and theatre staff are essential.

Anæsthesia.—I am fortunate in having Dr. Gillies as my anæsthetist. He induces anæsthesia with pentothal, and maintains it by cyclopropane and oxygen given through a cuffed oro-tracheal tube, using controlled respiration. Throughout the operation d-tubocurarine is given as required.

Operation.—A long left muscle-splitting paramedian incision gives satisfactory exposure. The spleen is mobilised by dividing the two layers of lieno-renal ligament: later this incision may need to be extended downward to give access to the kidney. The blood content of a large spleen may be returned to the general circulation by the elegant if somewhat academic method of applying a brisk faradic current to the splenic pedicle, or by slowly injecting into the artery 0·5 c.c. 1/1000 adrenalin hydrochloride diluted to 10 c.c. with normal saline solution. The splenic pedicle is dissected to the hilum, in order to obtain the longest and largest terminal branch of the splenic vein for the anastomosis. If the splenic vein is short, it may be necessary to dissect it along the upper border of the pancreas, care being taken to secure all the pancreatic veins which join it: this is best done after removal of the spleen. The vein is controlled by the placement of a rubber-shod bulldog clamp, dipped in sterile liquid paraffin so that it will not dry and stick to the vein, and applied by grasping it with a pair of large curved artery forceps. I have found it easiest to insert four stay sutures at equidistant points at the mouth of the vein, and to use these for drawing it through and everting it over the cannula. During this part of the operation the cannula may be held steady by a long Mayo needle-holder. The splenic vein is then washed out with sterile isotonic citrate solution and laid aside under a gauze swab moistened with citrate solution.

The left kidney is then delivered, the ureter tied and divided, and the vessels isolated as close to the hilum as possible. The renal vein is

dissected medially, care being taken to preserve the adrenal vein, which joins it above, and the spermatic or ovarian vein, which joins it below. The renal artery is divided between ligatures ; the renal vein is controlled by a bulldog clamp, divided near the hilum, and the kidney is removed. The lumen of the vein is washed out with citrate solution, and four equidistant sutures inserted in its open end. These are used to draw the renal vein over the cannula on the splenic vein. The anastomosis is completed by tying one silk ligature above the flange on the cannula, and a second (less tightly) near its orifice. The clamp on the renal vein is first removed, and then that on the splenic vein. In one case I was unable to make a satisfactory anastomosis with a cannula, because the splenic vein was so much larger than the renal, but I was able to unite the veins by end-to-end suture, which produced a functioning anastomosis. The area is reperitonealised by suturing the lateral edge of the peritoneal incision over the kidney to the medial edge of the opening in the gastro-splenic omentum made to expose the splenic pedicle.

After-treatment.—The patients have been nursed for the first twenty-four hours with the foot of the bed raised in order to encourage a rapid flow in the vena cava. After six hours a small quantity of heparin is added to the plasma drip infusion, the dose being adjusted so as to keep the clotting time at about fifteen minutes. After twenty-four hours heparin is discontinued.

Discussion

However attractive the provision of a shunt may be in the treatment of portal hypertension, it will be many years before any assessment can be made of the value of the operation in preventing fatal hæmatemesis. Patients may live as long as thirteen years after splenectomy alone. In these cases the prognosis depends upon the degree of damage to the liver, and upon the adequacy and rapidity of response of the collateral venous circulation—factors which may continue to operate after a shunt has been established. The accumulation of a number of cases, and their careful analysis, provide the only method of clarifying this point.

A second point which must await determination is the possible beneficial effect on hepatic function, which may result from the reduction of blood-pressure in the hepatic sinusoids, which at least temporarily must follow the establishment of a shunt.

The following papers may be consulted by those interested :—

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VOGUE AND FASHION IN ABDOMINAL SURGERY

Bradshaw Lecture delivered at The Royal College of Surgeons of England

on

13th November, 1947

by

Sir Cecil Wakeley

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The Bradshaw Lecture perpetuates the memory of William Wood Bradshaw a Fellow of this College who died in 1866. The lecture was founded by Mrs. Bradshaw in memory of her husband.

Bradshaw studied at The Middlesex Hospital and after qualifying in 1833, when he became a member of this College he practised at Andover and later at Reading, where he met his wife. During his training at The Middlesex Hospital, Bradshaw frequently paid visits here and was particularly interested in the surgical specimens and was stimulated by the skill and enthusiasm of Cliff who was Conservator in those days.

Fig. 1
William Wood Bradshaw

Before his death Bradshaw came under the influence of James Moncrieff Arnott, who was surgeon to The Middlesex Hospital and President of this College. Arnott secured a grant of £15,000 from the Government for the rebuilding of the museum.

This College has indeed been fortunate in the Presidents, who have been associated with The Middlesex Hospital; to mention only a few, Sir Henry Morris, Sir John Bland-Sutton and Sir Alfred Webb-Johnson; these men have stimulated such men as Bradshaw and brought them in contact with this College of ours.

The subject of my lecture is one which has interested me from my student days, when it appeared that various surgeons at the same hospital performed an operation for such a simple condition as an inguinal hernia in completely different ways.

During the last hundred years surgery has progressed by leaps and bounds, but even to-day, there is as much vogue and fashion in abdominal surgery as there is in ladies' hats. Fashions come and go, operations for certain conditions seem to have their day, they are forgotten and after a period of years the same operation comes into vogue again and is hailed almost as a new discovery.

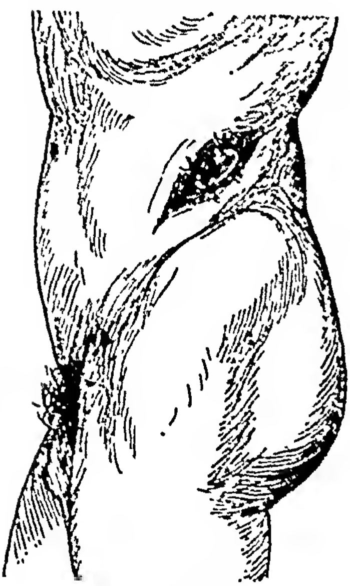

Fig. 2
Lumbar Colostomy

A hundred years ago surgeons performed a lumbar colostomy for carcinoma of the rectum, a fact that is entirely forgotten by modern students and nurses. Can we say that the operations on the abdomen are standardized to-day? I think not; even the operation of colostomy can be performed, and is performed, in many different ways.

It is impossible for me to cover the whole field of abdominal surgery and review the various types which have been in vogue during the last century and I shall limit myself to the alimentary tract.

Abdominal Incisions

It has always been a surgical axiom that in the surgery of the abdomen, the incision should be adequate, and direct surgical approach should, if possible, be carried out. In the pre-Listerian era abdominal operations were not frequent because of the danger of peritonitis, but those that were performed were generally through the mid-line. Incisions should be so placed as to ensure an effective blood-supply, and thereby avoid the risk of defective union or of post-operative hernia. Naturally, the middle line from this point of view is not desirable, and the linea semilunaris is even worse. Yet to-day one finds surgeons who invariably employ a mid-line incision and it is much favoured by gynæcologists.

Transverse incisions have become the vogue in recent years for operations such as partial gastrectomy and those dealing with pelvic lesions. Transverse incisions, if they transverse the tendinous intersections of the recti muscles, are anatomically and surgically sound, as no nerves are injured and the exposure is excellent. The chief difficulty lies in gaining effective union of the divided ends of the recti muscles. To prevent their retraction the fibres must be carefully stitched with mattress sutures to the anterior wall of the sheath before being divided.

The paramedian incision has enjoyed a popularity ever since it was introduced, and is to-day the favourite with most surgeons for abdominal operations.

Subcostal incisions for gall-bladder surgery or removal of the spleen have had their advocates and still have them but, although the exposure is an excellent one, there is a real danger of injury to the lower thoracic nerves and a ventral or incisional hernia in this situation is almost impossible to cure.

The oblique muscle-cutting operations in the iliac fossæ have become popular largely due to the advocacy of Grey Turner. They give excellent exposure in operating on cases of malignant disease of the colon and they are anatomically sound as the incision follows the direction of the nerves and therefore post-operative hernia is exceedingly rare.

During recent years considerable attention has been given to the study of the nerve supply of the abdominal wall. As far as possible the incisions should be planned so as to avoid division of the motor nerves, especially those going to the rectus abdominis, in so much as paralysis of this muscle may result in considerable discomfort, and loss of tone of the abdominal wall may follow. From this point of view an incision through the linea semilunaris is one of the worst that could be devised, and the paramedian incision, with displacement of the rectus outwards, the best.

The two world wars have done much to popularise the thoraco-abdominal approach for lesions in the stomach.

Cardiospasm or Achalasia of the Cardia

Cardiospasm or achalasia of the cardia is a condition in which there is no concensus of opinion as to the correct line of treatment. Physicians treat the condition with Hurst's mercury-loaded bougies. Laryngologists pass an œsophagoscope and dilate the cardiac orifice with bougies. The thoracic surgeon on the other hand exposes the lower end of the œsophagus through a thoracic approach; he then incises the diaphragm and pulls up the fundus of the stomach and anastomoses the dilated lower end of the œsophagus to the stomach.

The general surgeon is content to open the abdomen and incise the stomach dilating the diaphragmatic hiatus with the fingers. More recently the operation of œsophagolysis and incision of the muscle coat has given excellent results and is, to my mind, the most rational operation for the condition. It should surplant all other operations. It is a simple operation and gives as satisfactory a result as does Rammstedt's operation for congenital hypertrophic stenosis of the pylorus (Figs. 3 and 4).

Some of our American colleagues advocate a cardioplasty for this condition uniting the cardiac end of the stomach and the œsophagus, similar to the Finney ploroplasty. The operation is in reality a gastro-œsophagostomy. A high abdominal incision is used, the left lobe of the liver is mobilised and the cardia is exposed. A tape is passed around the cardia and traction is exerted, and the lower end of the thoracic œsophagus

is exposed by blunt dissections. An anastomosis is then completed between the lower end of the œsophagus and the cardia. This operation is popular in America and it is said to give good and permanent results. Whatever operation is performed for this condition the dilatation of the œsophagus persists for many years.

Operations for Peptic Ulcer

It is in the surgical treatment of peptic ulcer that vogue and fashion seem to run riot and many are the operations that have been devised for the cure of this condition.

These variations only go to prove that there is no stable or standardized operation for this condition; and it must be acknowledged that large gastric resections reflect our inability to cure peptic ulceration by other means. Let us hope that ere long some drug will be discovered that will influence the development and cure of this common complaint.

During the last hundred years the surgery of the stomach for ulcer has passed through phases, in which gastro-enterostomy, V-shaped excision for ulcer, pylorectomy, sleeve resection, partial gastrectomy and finally subtotal gastrectomy with or without vagotomy have had their turn (Fig. 5). Yet none of these operations will completely eliminate the development of anastomic ulceration.

Braithwaite, who delivered the Bradshaw lecture in 1942 discussed the rôle of bile in duodenal regurgitation and analysed 64 cases of gastric

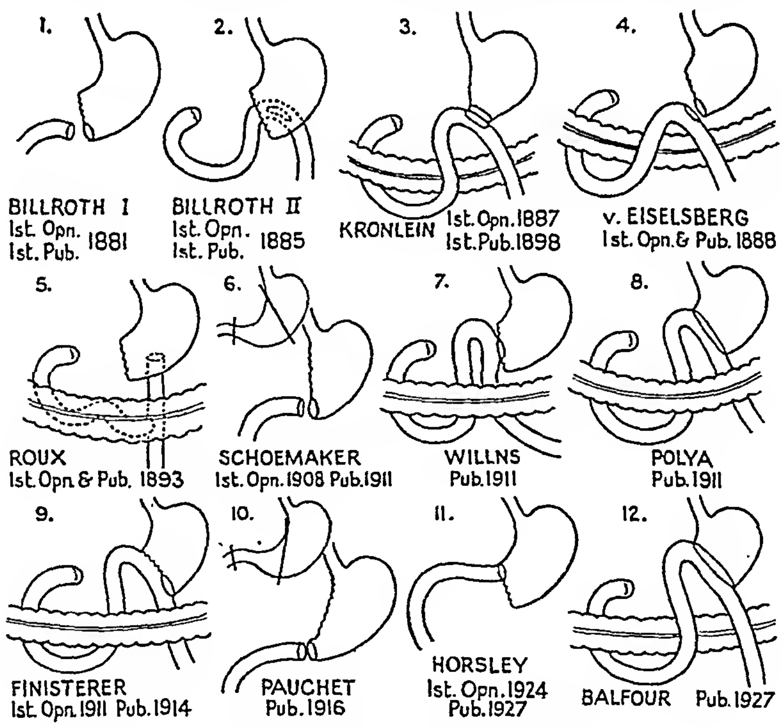

Fig. 5. A few of the earlier forms of partial gastrectomy

ulcer in which he had performed cholecysto-gastrostomy. His results did not seem to justify the operation and he stated that he abandoned the operation in 1936. Yet one finds from time to time, that this operation is still performed for inaccessible gastric ulcer with good results.

Physiological gastrectomy or vaso-ligation has had its advocates especially Wilson Hey of Manchester and Somerville of Travancore, and there can be no doubt that this operation gives excellent results in a proportion of cases, but no doubt vagotomy will replace it in time. It is interesting to note that it is impossible to produce necrosis of the stomach wall even after the most complete vaso-ligation. It may well be that the very vascularity of the stomach in itself has enabled surgeons to perform such diverse excisions with almost impunity.

Gastric Ulcer

Is quite a different clinical entity from duodenal ulceration and the tendency has been to advocate more drastic gastrectomy during the last decade. After the first World War subtotal gastrectomy became the vogue because it was stated that anything up to 90 per cent. of gastric ulcers were liable to become malignant. The pendulum then swung the other way and a figure of 5 per cent. was considered a reliable one. To-day the pendulum is swinging back again and in many clinics, both in this Country and in America, the figure ranges between 15 and 20 per cent. Although gastro-enterostomy has been and is still performed for gastric ulcer, the fashion is almost obsolete, as subtotal gastrectomy has taken its place. But there is no agreement among surgeons whether gastrectomy should be retro-colic or ante-colic or whether a valvular gastrectomy should be performed or not.

In the plethora of surgical literature one reads eloquent but dictorial statements to the effect that there can be only one subtotal gastrectomy, and that is the retro-colic valvular gastrectomy and that no other operation should ever be performed. I must be completely out of fashion as I always do an ante-colic gastrectomy and I know of many other surgeons who do the same. The operation is a sounder proposition and should a gastro-jejunal ulcer appear it can be dealt with, but I know of no more difficult condition than that of an ulcer which has arisen following a retro-colic valvular gastrectomy—and they do occur—their occurrence being obvious in those clinics where the " follow up " is run on sound lines.

Vagotomy is in vogue at present for the cure of peptic ulcer, so much so in fact, that in some surgical clinics it is the only operation performed for ulcer of the lower part of the fore gut. Should vagotomy be performed through the abdomen or through the thorax, should it be combined with gastro-enterostomy or partial gastrectomy or should it be reserved for recurrent ulceration? These are the questions that surgeons all over the World are considering to-day, and a rational and surgical common

sense attitude should be adopted. There is a tendency for surgeons to perform vagotomy, because it is the fashion or because they want to have performed a hundred or more cases. Few cases carefully documented and painstakingly followed up are of far more value than mere numbers of operations.

Duodenal Ulcer

There are more operative measures described for duodenal ulcer than I have time to discuss and vogue and fashion will vary with different surgeons. Simple excision of the ulcer has been advocated in the past but has few adherents to-day.

Pyloroplasty still has supporters both in this Country and abroad. The operation aims at partial excision of the pyloric sphincter and an anterior wall ulcer, allowing regurgitation of the alkaline duodenal contents into the stomach and thus counteracting the acidity. Horsley has advocated this type of operation for many years but to my mind it has many limitations.

Judd's Pyloroplasty is more extensive and is in reality a plastic operation on the pylorus.

Gastro-duodenostomy was advocated and popularised by Finney and is a sounder operation than Pyloroplasty as the stoma is much larger and more efficient but the operation requires mobilisation of the duodenum. Jaboulay's operation is probably better, but more complete mobilisation of the first and second parts of the duodenum is necessary.

Partial Fundusectomy and Gastric exclusion are the other methods which have been practised by surgeons of the calibre of Connell and Devine but have but very few supporters at the present time. Crille has advised adrenal denervation for peptic ulcer with the idea of controlling hyperactivity of the stomach but this method has not been followed by many surgeons.

A considerable number of duodenal ulcers heal completely, some of these in the healing process cause pyloric stenosis. It must be remembered that pyloric stenosis is virtually always duodenal stenosis.

Posterior gastro-enterostomy has been in vogue for pyloric stenosis for many years and in my opinion gives excellent results. In fact I would postulate that posterior gastro-enterostomy is still the ideal operation for organic pyloric stenosis. During the years 1915-1945 I have performed the operation 225 times including 10 cases in which the patients were medical men. The mortality rate was 1·5 per cent. and the " follow up " has revealed two cases in which gastro-jejunal ulceration occurred, but the rest of the cases gave completely satisfactory results.

To-day there is a tendency to decry the operation of gastro-enterostomy for pyloric stenosis and advocate subtotal gastrectomy. The only late

complication of gastro-enterostomy is an anastomotic ulcer and the incidence of this varies up to 10 per cent. and these cases can now be treated by trans-thoracic vagotomy.

There can be no doubt that at the present time the incidence of peptic ulceration shows a big increase, there being about a million cases in the whole of Great Britain. Conditions are favourable for the production of peptic ulceration; fear, lack of essential foods and difficulties in obtaining the amenities of life. The increase in incidence will slowly mount, unless these conditions are altered. The medical profession as a whole should apply all its resources to conquer this disease. Vagotomy is the vogue at the moment, but it can at best, only reduce hypersecretion and diminish gastric motility. Some authorities even go as far as to say Vagotomy is quite unjustifiable, but vogue and fashion will have their day. " *Exemplo plus quam ratione vivimus.*"

Congenital Pyloric Stenosis

Some Clinicians dislike the term congenital attached to this well-known condition on the plea that the usual time at which it makes its appearance is about the third to the sixth week after birth. This is so, but the condition has been found in eight-month fœtuses and in full-term babies so I consider the title correct.

Gastro-enterostomy has been performed for the condition but it was very difficult and carried a high mortality.

Burghard popularised dilatation of the pyloric sphincter with a metal dilator, the dilatation being pushed until the circular muscle coat ruptured, the mucous membrane then herniated through this rent and prevented any union of the ruptured muscle fibres. As the dilatation was carried out through an incision in the stomach, after the dilatation was complete, a rubber catheter was passed into the duodenum and a feed of milk and brandy was given; this often proved very beneficial to the infant.

Pyloroplasty was also performed but was difficult and carried a high mortality.

It is interesting to recall that in 1911 Rammstedt was performing a pyloroplasty on a case of pyloric stenosis. After cutting through the hypertrophied muscle ring he endeavoured to stitch this thick mass of muscle in a vertical manner but all his stitches cut out, so he was forced to sew over the defect, some omentum. The convalescence was complicated by vomiting, and this made Rammstedt think that perhaps sewing omentum into the defect caused the mucous membrane to be thrown into folds, and produced in this way a partial obstruction of the pylorus. He decided, therefore, that in his next case he would incise the circular pyloric muscle and do nothing more. He did this for the first time on June 18, 1911 and the result was entirely satisfactory and

Rammstedt's operation was born and to-day is universally acclaimed the standard operation for congenital pyloric stenosis.

The Small Intestine

The surgery of the small intestine is more or less limited to that for the cure of obstruction. Inguinal and femoral hernia play an important part in the cause of this condition. It is the last loop of the ileum that comes into contact with the four hernial orifices, as this loop is invariably found in the pelvis.

Inguinal Hernia

The incidence of inguinal herniæ has always been high, right down the ages and many and varied have been the operations which have been devised for the cure of this condition. My colleague Harold Edwards a few years back, in a critical review on inguinal hernia, published the hernia calendar.

THE HERNIA CALENDAR

900 B.C.		Treatment by girdle and compresses by the Phoenicians.
400 B.C.		The writings of Hippocrates.
1st Century A.D.		Cecsus. Ligature and excision of the freed sac.
2nd Century A.D.		Heliodorus. Ligature and excision of the freed sac.
4th Century A.D.		Oribasius. Ligature and excision of the freed sac followed by cautery.
7th Century A.D. (The Dark Ages)		Aeginata. Ligature and excision of the freed sac.
16th Century A.D.		Pare. Obliteration of sac by tension ligature and sloughing.
16th Century A.D.		De Garengeot. Dissection of sac, rolling into pad and suturing into inguinal canal.
1836	Bonnet	Cure by sepsis.
1840	Wutzer	Seton Treatment.
1844	Pancoastin	Injection of iodine.
1851	Velpeau	Exposure and opening of sac and application of iodine.
1857	Wood	Subcutaneous operation for ligature of sac (Lister).
1881	Marey	High ligature of sac and transplantation of cord and reconstruction of canal.
1886	MacEwan	Plugged internal ring with rolled up sac.
1889	Bassini	High excision of sac and posterior repair (development of Marey's operation).
1889	Halstead	Use of cremaster fascia and over-lap of external oblique.
1895	Andrews	Channel for cord made in external oblique aponeurosis.
1897	Fowler	Dissection of deep epigastric and intra-peritoneal transplantation of cord.
1898	Brenner	Use of cremaster to reinforce canal.
1898	Bloodgood	Transplant of rectus muscle and sheath.
1899	Fergusson	Suture of internal oblique and conjoined tendon over the cord.
1904	McArthur	Fascial suture obtained from external oblique aponeurosis.
1905	Scott	Relaxation incision in rectus sheath.
1906	Torek	Dissection of cord and separation of vas from vessels.
1908	Edmunds	Abdominal approach for bilateral hernia.
1909	McGavin	Filigree operation.
1910	Kirschner	Fascial transplant from thigh.
1911	Downes	Rectus muscle to Poupart's ligament.
1913	Hull	Ligation of sac with minimum disturbance.
1913	Bates	Small incision. Peritoneum opened at internal ring.
1916	Watson	High transplant cord.
1919	La Roque	Transperitoneal ligature of sac.
1921	Gallie	Repair by living sutures.

This is an interesting list of operations which have been in vogue in the last three thousand years. Each operation has had its day, it has then been superseded by another. Bassini's operation has been in use for a longer period than most and yet to-day comes in for the most criticism because it interferes with the normal myodynamics of the area.

The filigree operation devised by McGavin in 1909 was abandoned ten years later and yet in my surgical travels I find it coming into fashion in several surgical centres. Surely it is high time the plastic surgeons devised a modern operation for this only too common condition.

Recurrences occur after every form of surgical repair, so much so, that the public are gulled into believing that no operation will cure a rupture and that some mechanical contraption at high cost is the only safe procedure. What is wanted is a sane common-sense surgical approach to the problem.

Recurrences are produced by lack of pre-operative treatment, inefficient and incorrect surgical repair and improper after-treatment.

The commonest cause of recurrence is incomplete removal of the sac, thereby leaving a potential new hernia.

The formation of hæmatomata, the occurrence of sepsis and too effective a repair due to excessive zeal on the part of the operator also play their role in the recurrence of the complaint.

To my mind there can be no standard operation for inguinal hernia; every case must be treated on its merits, consideration of the existing defect, by careful dissection and examination must be made. In many cases a small direct hernia is present at the same time as an indirect hernia; and if this is overlooked a failure is certain and the operation, whatever it may be, is blamed, instead of lack of observation.

Suture material for the repair of hernia has varied from thread, catgut, silkworm gut, Chinese silk, floss silk and homologous and autogenous fascia. At the present time silk sutures are the fashion.

Recurrences of direct herniæ are in my opinion commonly due to paraperitoneal hernia of the bladder and unless this complication is recognised any repair is useless and a second recurrence will take place.

Femoral Hernia

Although the various operations that have been devised for the cure of femoral hernia are not so numerous as those for the cure of an inguinal hernia, yet they are considerable. At the present time two methods of approach have been recognised as standard procedures for the cure of this form of hernia—the femoral or low approach through Scarpa's triangle—and the inguinal or high approach through the inguinal canal. Opinions differ, as to which method is superior, and often feelings run high. The inguinal approach first advocated by Annandale in 1876, although priority has been erroneously given to Lotheissen, is useful in

cases of strangulation, while the femoral approach is satisfactory in other cases.

However, many other operations have been in use for the cure of a femoral hernia. Roux used a metal staple to fasten the Poupart's ligament to the horizontal ramus of the pubis ; this operation was discarded because the staple often became loose and tended to migrate in the body. Nichol of Glasgow made use of silver wire sutures to fasten Poupart's ligament to the pubis and other surgeons used silk for the same purpose. Lenthal Cheatle conceived the novel idea of excising part of the internal saphenous vein and plugging the crural canal with this structure. Other operations have been devised in which fascia, periosteum, and muscles have been used to obliterate the crural canal. All these operations are only of historic interest.

Umbilical Hernia

In considering the various methods which have been in vogue for the treatment of umbilical hernia in adults it must be remembered that this condition is always a serious one.

Mechanical treatment by means of pads and trusses of metal, wood and hard rubber have all had their day and at best it may be said that each and every one increases the incidence of strangulation. To apply a truss to an irreducible umbilical hernia in an adult is in my opinion a surgical crime.

Because of the constant danger of strangulation in irreducible herniæ, operation has been advised in most surgical clinics for the last sixty years. Prior to the introduction of the Mayo operation, umbilical herniæ were treated by excision of the umbilicus and surrounding area, by means of an elliptical longitudinal incision.

The adherent omentum was excised and any adhesions between the deep aspect of the umbilicus and the gut divided. The peritoneum was then closed and the attenuated linia alba was overlapped to gain surface-to-surface union. Stitches were then passed through both recti and an attempt made to approximate these muscles. This operation, though frequently performed, was doomed to failure, as the stitches cut out as soon as the patient strained or coughed. Many burst abdomens were the result.

In the Mayo operation for umbilical hernia, transverse crescentic incisions are made both above and below the hernia so as to encircle it. The sac is carefully defined and cleared of fat, as also the aponeurosis of the recti muscles for some way around. The aponeurosis is then divided close to the neck by transverse incisions, and the sac opened. The contents are turned out and examined. Omentum is almost always present, and often adherent, both to intestine, sac and margins of the opening. Generally speaking, most of the omentum thus found is removed ; it

usually constitutes a thick fibro-fatty mass, tangled and adherent, and useless as omentum. Special care is directed to the margins of the opening, which must be completely cleared. The intestine, both large and small, is generally reduced without difficulty when the omentum is set free. The sac, the adherent tags of omentum within it, and the overlying skin are then cut away completely, and great care is taken to secure hæmostasis of the cut edges. The opening is now limited by two peritoneo-aponeurotic flaps, above and below respectively, and is closed by superimposing the upper of these over the lower, by means of mattress sutures introduced through the margins of the lower and passed under and through the upper from within outwards, as far up as one can conveniently reach. The upper flap is then stitched down over the lower, which it usually overlaps to the extent of nearly two inches. The subcutaneous tissues are brought together by buried sutures; provision is made for drainage. I have described Mayo's operation in a little detail because I consider it to be the stabilised operation the world over for umbilical hernia in adults. Although William Mayo first described his operation in 1894 it is only in the last thirty years that it has become the operation of choice for umbilical hernia. However, as Joseph Warton said in the eighteenth century:

> "Disguise it as you will
> To right or wrong 'tis fashion guides us still."

This being so it is understandable that Humberto Barreto of Rio de Janeiro should describe yet another operation for the cure of umbilical hernia in 1946. This operation reveals much ingenuity on the part of the Brazilian surgeon. The operation is performed by making two transverse skin incisions to circumscribe the hernia, the central part of the upper incision is deflected downwards outlining a flap which contains the umbilicus. The umbilicus is saved for æsthetic reasons according to Barreto! The skin flap is raised and removed, and the hernial sac is opened and its contents reduced inside the abdominal cavity. The small skin flap containing the umbilicus is freed. The peritoneum is closed by means of a purse string suture. Just above and below the line of peritoneal closure two parallel incisions are made through the aponeurosis. The edges of the incisions are undermined and the two inner aponeurotic flaps are turned towards each other and sutured. The outer flaps are then approximated. This operation provides three aponeurotic layers superimposed over the weak area. The skin is then closed. It remains to be seen if this type of operation will be adopted.

Injection Treatment for Hernia

This form of treatment has been in vogue throughout the last century. George Heaton of Boston was one of the first to advocate it in 1842 and since his day many and varied have been the solutions which have been advocated ranging from alcohol, iodine, tannic acid, quinine, zinc

Fig. 3.

Œsophagolysis. Exposure of the cardia by means of an incision through the peritoneal coat.

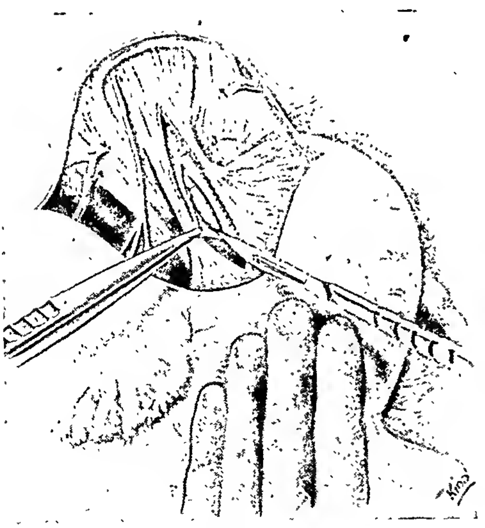

Fig. 4.

Œsophagolysis. Cutting through the muscular coat of the lower end of the œsophagus and permitting the lining membrane to bulge through.

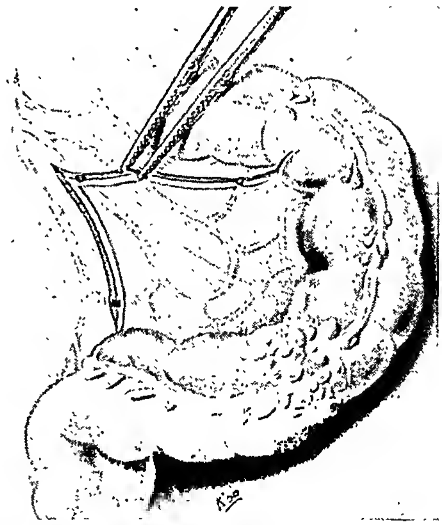

Fig. 6.

Carcinoma of the sigmoid colon.

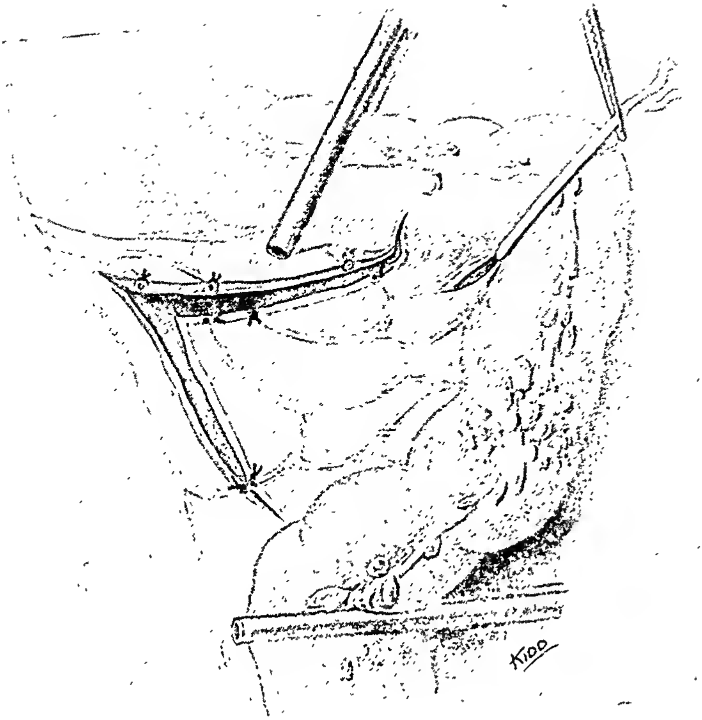

Fig. 7.
Carcinoma of sigmoid colon, clamps applied prior to excision.

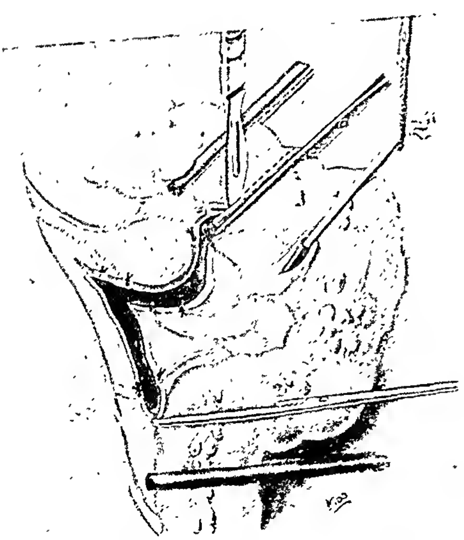

Fig. 8.
Excision of carcinoma of sigmoid colon.

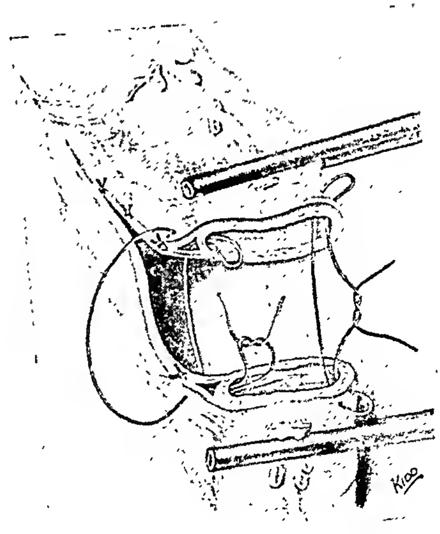

Fig. 9.
Method of end-to-end union in the sigmoid colon.

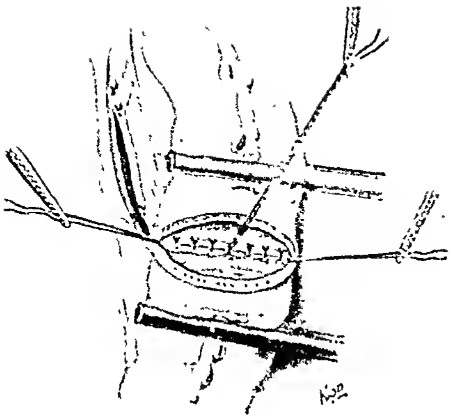

Fig. 10.

Suturing the gut.

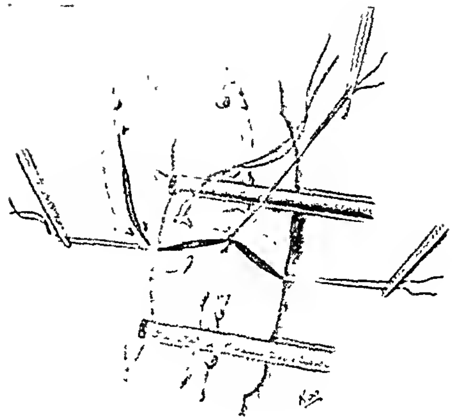

Fig. 11.

Suturing the gut later stage.

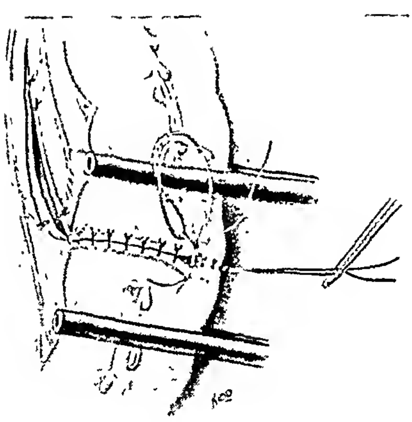

Fig. 12.

Final sero-muscular sutures.

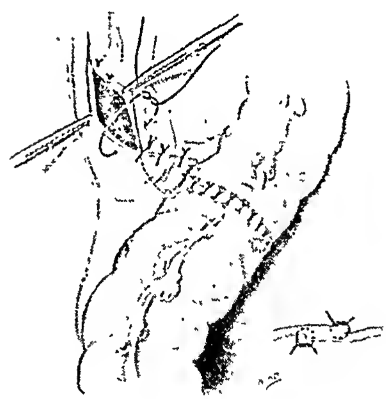

Fig. 13.

Closing the defect in the meso-sigmoid.

PAINTING OF THE 1946-47 COUNCIL OF THE ROYAL COLLEGE OF SURGEONS PRESENTED TO SIR ALFRED WEBB-JOHNSON, Bt. BY MR. HENRY CARR.

In front of the table, standing, from left to right: Sir Hugh Cairns, Mr. Philip Mitchiner.

Sitting, from left to right: Mr. L. E. C. Norbury, Mr. Zachary Cope, Mr. G. L. Keynes.

Behind the table, standing, from left to right: Mr. Tudor Edwards, Sir Max Page, Mr. Finch, Mr. Love, Sir Reginald Watson-Jones, Mr. Burgess, The President: Sir Alfred Webb-Johnson, Mr. Souttar, Prof. Harry Platt, Mr. Julian Taylor, Prof. Lambert Rogers, Prof. G. Grey Turner, Sir Gordon Gordon-Taylor.

Sitting, from left to right: Prof. Paterson Ross, Sir Heneage Ogilvie, Sir Cecil Wakeley, Sir James Walton, Mr. R. J. Willan, Mr. Scott Mason.

sulphate, phenol, blood, tobacco, ammonia, essential oils, olive and linseed oils, tincture of cantharides, morphine sulphate, ether, chloroform and sodium morrhuate. To-day the drug in use is sodium morrhuate.

It is interesting to note that Clarke in his Manual of Surgery, published in 1879, considered that the injection method had the merit of simplicity.

To my mind there is always a group of patients who, for one reason or another, should be offered injection treatment for the cure of their ruptures. Aged invalids and debilitated patients and those who refuse operation and do not desire to wear a truss are suitable for injection. The method is ambulatory, painless and no anæsthetic is necessary and a cure is obtained in a fair proportion of patients.

It is probably a more fashionable procedure in the United States than in this country and it is not generally understood that not only must the patient wear a truss day and night during the period that the injections are being given but also for two months after the last injection. Injection treatment can be used for inguinal, femoral or umbilical herniæ.

Surgery of the Colon

The surgery of the colon is in reality the treatment of carcinoma of the colon.

During the last forty years considerable progress has been made in the treatment of colonic surgery and the avoidance, wherever possible, of a permanent colostomy. The progress has been due to the fact that colonic growths, even if adherent to other viscera, are often removable and give the patient a good chance of complete recovery. Foremost in this constructive teaching are the names of Grey Turner and Gordon-Taylor and I shall always be indebted to them for their teaching and encouragement in the treatment for what may appear to be inoperable growths of the colon. During the last fifteen years I have operated on ten cases which at operation appeared to be quite inoperable owing to the involvement of loops of small intestine, stomach, liver, spleen or kidney and yet in each case a successful operation was completed after drastic excision.

Resection of the right side of the colon may be done in one stage, as there is rarely obstruction from the growth. The ileocolostomy, however, is where vogue and fashion come into their own. Some surgeons advocate an end-to-end anastomosis, others end to side, while the rest are convinced that a lateral anastomosis is essential. The anastomosis may be performed by an open suture or with a Murphy button or by a close method. Resection of the left side of the colon can rarely be achieved until a decompressive operation, in the form of a cæcostomy or colostomy has been established. However, fashion is changing, and in those cases where early diagnosis is possible before obstruction supervenes, excision of the gut with end-to-end suture is the choice (Figs. 6, 7, 8, 9, 10, 11, 12 and 13).

In those cases where there is not equality in size of the bowel above and below the growth, air can be injected through the rectum by means of an insufflator. After the abdomen has been opened a nurse pumps air into the rectum and the surgeon observes the dilatation of the distal part of the colon until it is equal in size with the proximal loop of gut. Double clamps are applied above and below the growth at sites determined beforehand. The placing of the clamps on both proximal and distal ends while the bowel is dilated with air ensures an equal diameter of the two ends. It must be admitted that the use of the Miller-Abbot tube, penicillin and the sulphonamide drugs have all played their part in making this form of treatment safe and satisfactory.

Paul's exteriorization operation is going out of fashion but in my opinion is still a very valuable operation in selected cases.

The words of that great American Surgeon, C. W. Mayo, are as true to-day as when he uttered them. "I never know until the abdomen has been opened and exploration has been completed what type of operation best suits the individual case."

For cases of carcinoma of the rectum there is a tendency both here and in America to try and preserve the lower end of the rectum and anal canal. This is possible in growths of the upper part of the rectum and the recto-sigmoid junction. For growths in the lower part of the rectum the abdomino-perineal—or the perineo-abdominal operation are the fashion at the moment. Perineal excision is not in favour but it does give good results in the aged and bad-risk patients.

Permanent colostomy must be performed in the vast majority of patients with rectal carcinoma and there is much diversity of opinion where the opening should be made. Some favour the left iliac fossa, others the mid-line after excision of the umbilicus. The mid-line colostomy has many advantages; it is easier to control, does not predispose to an inguinal or femoral hernia and is far more comfortable.

The second World War with its low mortality figures for gunshot wounds of the abdominal viscera left a large number of colostomy cases which eventually required closing. The almost universal use of the double-barrelled colostomy made closure easy; but, in certain cases the closure of the colostomy has proved a major operation and many and varied have been the procedures for such an operation.

DINNER TO SIR ALFRED AND LADY WEBB-JOHNSON

A DINNER WAS GIVEN at The Royal College of Surgeons on Thursday, November 13th to Sir Alfred and Lady Webb-Johnson by Councillors of the College for the year 1946-47. On this occasion a presentation of a painting was made by Sir Cecil Wakeley, Senior Vice-President who said :—

" Ladies and Gentlemen, to-night I have the honour and privilege to be the spokesman of the Council of this College and to express on their behalf—however inadequately—the feelings of affection and gratitude to our President.

' Webb,' as he is known to us all occupies the unique position among the Presidents of this College, of having held the Presidency for seven years.

These years have been by no means easy ones, as all of them have presented war or post-war problems.

During all the war years the President never left the College, he was here each day steering it through its difficulties and by his calm and inspiring presence leading all those here ' to Victory.'

He not only found time for this but had the vision and driving force to form a constructive programme for the future and post-war life of the College.

By hard work and sheer force of will he has started the ball rolling for rebuilding and expansion and what is more, has been instrumental in collecting a tremendous nucleus of funds to carry this out.

To-day this College forms the head and the spiritual home (as he has often said) of all its Fellows and Members whether here or in the Colonies or even for the surgeons of all other Countries and they all feel the warmth of its welcome and the drawing of the threads of friendship and co-operation.

We hope that he will never lose this interest or cease working for and with us.

I now come to the further object of our meeting here to-night that is to make a presentation of a painting of this Council by Mr. Henry Carr and we all sincerely hope that it will give our President as much pleasure in receiving it as his Councillors have in giving it.

We have felt that Sir Alfred's long and distinguished service merited something that was permanent and that could be handed down to posterity.

Mr. President your Council ask you to accept this picture as a token of their love, esteem, and friendship, and hope that it will prove a source of great satisfaction to you. We would like to voice the sentiments of La Bruyere who said, ' Eminent posts make great men greater, and little men less.' "

In his reply, Sir Alfred said: " My dear Friends and Colleagues, How can I help being deeply moved by the unique compliment and most generous tribute you pay me? What Cecil Wakeley has said of me I can only ask you very kindly to try to believe. You have done me a great, a very great, honour, one which I make bold to hope is not so much offered to me as to the work which we have been fortunate enough to carry out together.

You could not have given me anything that I would have counted a greater honour, or that could have given me so much pleasure as the present of this portrait group of those with whom I worked during the sixth year of my Presidency. It is a great source of pride to me that you have provided me with the opportunity of ensuring that the Councillors with whom I have worked shall be commemorated on the walls of the College we all love and try to serve faithfully. I am profoundly grateful for your generosity and kindness to me.

I cannot but be acutely conscious of the empty chair of our dear friend Arthur Tudor Edwards, for whose loss we grieved early in this memorable year. I deeply appreciate the presence here to-night of his beloved wife.

Nor can I help but recall with deep sorrow that during my Presidency I have had to mourn the loss by death of three other trusty friends and colleagues—Leonard Braithwaite, Girling Ball and Cecil Joll.

Besides being inspired by the task which you entrusted to me and by the loyal help that you and the Fellows and Members of the College have given me I have been wonderfully supported throughout these difficult years by the staunch encouragement and ready sacrifice of my wife. You will have appreciated from her display of energy, enthusiasm and organizing ability during the recent Congress of the International Society of Surgery that she has got me thoroughly organized and properly taped.

An unpublished tribute paid by Rudyard Kipling to his wife seems to fit my feelings to-night. He wrote as follows:—

" He's the man that wrote The Jungle Books
—likewise The Seven Seas
He's the man that knows the private soldier's life—
He's the man that gets the credit
—but he owns on bended knees,
He isn't any good without his Wife."

The loss which our beloved College sustained was serious—but in the great event it was but an incident, and one which we counted it a privilege to repair. We regarded the disaster as a wonderful opportunity to build on the old foundations a College worthy of its glorious past and of its splendid future. What high destiny to be on the Council now, when every step we take is history! We are privileged to pave the way for the finest hour in the history of our College.

What joy and interest we have had in our task, and with what zest it has filled us! And zest is essential for success in such a mighty project, for nothing great was ever achieved without enthusiasm. How could we fail to be inspired by our tremendous trusteeship—the everlasting possession which we hold and constantly embellish for the surgeons of the world?

We plan to build in accordance with our traditions—for counsels to which history is not called history will not ratify. Already we have reaped rich fruits from being mindful of our history. By reviving and expanding our old activities to their fullest extent we have re-established the College as a great teaching centre, which is generally recognised and acknowledged as the natural post-graduate surgical centre of the Empire.

This has been made possible by the princely generosity of Sir William Collins, and the magnificent gifts of our other great benefactors—Sir Erasmus Wilson, Sir Buckston Browne, the Bernhard Baron Trustees and the Trustees of the Will of Sir Henry Wellcome. Sir William Collins' support has been an essential factor in our success, for the only absolute safeguard for free development is the possession of an income of which the greater part comes from endowments.

There are difficulties ahead, but we shall go steadily on from strength to strength—ever onwards—fortified by the knowledge that our College is destined to hold a greater and greater place as an arbiter of Surgery, and as a centre of independent authority and of surgical education and research. In the field of post-graduate education we must co-operate cordially with the Universities and the Sister Colleges. In our plans for post-graduate teaching we are particularly anxious to work in the closest possible partnership with the University of London.

We have to be patient in regard to building, but a time will come when our plans can be carried out. The attainment of our goal will depend not only on us but on our successors. As the inaudible and noiseless foot of time steals on we are happy in the knowledge that there are young, capable and eager hands waiting to grasp the torch, and to devote themselves to the service of this wonderful College. We have no doubts or fears for the future for we know that they will prove themselves worthy of the prize.

I often think of "London Pride" as our Metropolitan emblem—I have always been full of pride for our College, and that you, my dear Friends and Colleagues, should show by your generous tribute to-night that you take pride in me is, in my view, the greatest reward that I could possibly receive.

Sir Cecil Wakeley: "My second duty is a most pleasing one and that is to toast our President's Lady. For all these years she has loyally and untiringly supported her husband. Always cheerful and kind she has welcomed all to this College, making even the most shy visitor feel at home and at ease. In all these ways she has gained our gratitude and

respect. We have been proud of her and it is with a very real feeling of regard that in the name of the Council of this College I present to her a small appreciation of our affection for her.

Lady Webb-Johnson will you do us the honour of accepting this powder-box with our love and affection?"

In her reply Lady Webb-Johnson said " Gentlemen, I am quite overwhelmed by all the kind things that Sir Cecil has said, and by the gift of this beautiful powder-box. I do not know how to thank the Members of the Council adequately. You have given me a lovely present and I shall prize it as one of my most cherished possessions.

I feel bound to confess that to-night Sir Cecil has taken a great load off my mind. I have so often been puzzled as to where my husband really did go every day—and now I know!

This certainly is my lucky day. I am invited to this delightful and enjoyable party—and now you give me this charming gift—and—just before I left home, I received a half ton of coal!

Thank you again for all your thought and kindness, and for a very wonderful and memorable evening."

"ROBIN ADAIR" (1711-1790)

ROBERT ADAIR, the Surgeon, was a romantic figure of the 18th Century. He became a Member of the Company of Barbers and Surgeons in 1738. He saw active service in Flanders and at the Siege of Quebec. In 1760 he was elected a Member of the Court of Assistants of the Company of Surgeons and became Master in 1767. He was appointed Surgeon to Chelsea Hospital in 1773 in succession to John Ranby, the first Master of the Company of Surgeons. He became Surgeon-General of the Army and Inspector-General of Hospitals.

Adair was the hero of the well-known song " Robin Adair" written by Lady Caroline Keppel, daughter of the second Earl of Albermarle, whom he married in 1759. He was father of the Right Honourable Sir Robert Adair, diplomatist, who was a close friend of Charles James Fox.

Adair was a contemporary of John Hunter and, as Inspector-General of Hospitals, gave Hunter his first appointment in the army as Staff-Surgeon. On Adair's death 30 years later Hunter succeeded him as Surgeon-General and as Inspector-General of Hospitals.

In the Memoirs of William Hickey there are some interesting references to Robin Adair. William Hickey was the son of Joseph Hickey who figures in Goldsmith's " Retaliation." In his Memoirs he gives frank and entertaining accounts of his weaknesses for women and claret.

In 1776 when Hickey was staying at Margate with his wealthy friend Mr. Cane, he fell asleep by the fire but awoke " in the tortures of the

Fig. 1.—Portrait in the Royal College of Surgeons presented by R. Bunderell Carter.

Fig. 2.—Mezzotint engraving by J. Jones from a painting by F. L. Abbott.

damned, bouncing up, and screeching with a dreadful pain in my right foot." His friend, in play, had put a lighted taper on his foot. Amusement soon gave place to consternation, and the local surgeon was sent for. He being apprehensive, Mr. Cane "instantly despatched an express to London to summon Mr. Robin Adair to come and attend me, but that gentleman happening to be at Bristol at the time, Mr. John Hunter, who had undertaken to act for him during his absence, instantly left town and came to me. After meeting the Margate surgeon and inspecting my foot he at once declared no ill consequence would arise, and that a few days' quiet, keeping my leg in a horizontal position, and frequently applying an embrocation which he ordered, would completely cure the

hurt. And so it proved ; in a week I was perfectly recovered, but during that period I was kept upon chicken broth, and not allowed a drop of wine, lest fever should ensue."

On another occasion (Autumn 1776), when staying with Mr. Cane at Erith, Hickey had " a bad sore throat," and Cane insisted on his going instantly to town to consult his surgeon, Mr. Robin Adair. " I accordingly, the next tide went in The Congress (Mr. Cane's Cutter) to Deptford, from whence I took a coach. I had the disappointment to find Mr. Adair had that morning departed for Ireland, and would be absent for at least a month. A friend whom he met sent Hickey to " Mr. Howard, of Bow Street, a man of superior skill in his profession, being the Chief Surgeon to The Middlesex Hospital."

Towards the end of January in the following year Hickey again had " a sore throat," and Mr. Cane immediately took him to Mr. Adair's. " Mr. Adair engaged to restore me to as good health as ever, to effect which I must go through the very unpleasant process of salivation." Sic ! ! Again all went well, and we read " Mr. Adair had been uncommonly attentive during my confinement, and, as his professional skill was of the very first rate, I felt confident of a perfect cure. On the 10th of March he pronounced me fit to embark for any part of the world, but he recommended me to use the warm bath and drink plentifully of Sarsaparilla for a fortnight."

A.W.-J.

DIARY FOR DECEMBER

(15th—31st)

Mon.	15	3.45	MR. D. W. C. NORTHFIELD—Intracranial Hydro-dynamics.
		5.00	PROF. A. HADDOW—Some Aspects of Carcinogenesis.
Tues.	16	3.45	PROF. C. M. WEST—The Skin.
		5.00	PROF. S. L. BAKER—The Absorption and Deposition of Bone.
Wed.	17	3.45	PROF. J. BEATTIE—Autonomic Nervous System (Central).
		5.00	PROF. J. W. S. BLACKLOCK—Surgical Tuberculosis of Bovine Origin.
Thur.	18	3.45	PROF. R. G. T. LIDDELL—The Pyramidal Nervous System.
		5.00	DR. J. HAMILTON-PATERSON—Reticulosis and Lymph gland Enlargement.
Fri.	19		D. I. H. Examination (Part II) begins.
		3.45	DR. J. D. ROBERTSON—Calcium Metabolism.
		5.00	DR. J. HAMILTON-PATERSON—Myelomata and their Relation to the Hæmopoietic Bone Marrow.
Wed.	24		College closed.
Mon.	29		College re-opens.
		5.00	MR. F. A. WILLIAMSON-NOBLE—Contact Lens.
Tues.	30	5.00	MR. A. G. CROSS—The Ocular Sequelæ of Head Injuries.
Wed .	31	5.00	MR. J. D. M. CARDELL—Orthoptics in Relation to Ophthalmology.

DIARY FOR JANUARY 1948

Thur.	1	5.00	DR. J. MARSHALL—Ophthalmology in Relation to the Throat and Nose.
Fri.	2	5.00	MR. L. H. SAVIN—Ptosis.
Mon.	5	5.00	MR. C. DEE SHAPLAND—Detachment of the Retina.
Tues.	6	5.00	DR. R. D. LAWRENCE—Diabetes and Ophthalmology.
			Final M.R.C.S. Examination begins.
Wed.	7	5.00	PROF. W. J. B. RIDDELL—The Analysis of Senile Cataract Distributions.
		7.00	Monthly Dinner for Fellows, Members and Licentiates.*
Thur.	8	5.00	MR. B. HUGHES—Interpretation of Visual Field Defects.
Fri.	9	5.00	MR. B. W. RYCROFT—Surgical Technique of Corneal Transplantation.
Mon.	12	5.00	MR. J. H. DOGGART—Slit Lamp Microscopy.
		5.00	PROF. WOOD JONES—Maxilla Development.
		6.15	MR. D. J. ANDERSON—Saliva and Salivary Secretion.
Tues.	13	5.00	MR. F. LAW—Physiotherapy of the Eye.
		5.00	PROF. M. A. RUSHTON—Developmental Anomalies.
		6.15	DR. E. W. FISH—Applied Anatomy of the Buccal Musculature.
Wed.	14	5.00	PROF. H. J. SEDDON—Bone Growth.
		5.00	PROF. E. C. DODDS—Hormones in relation to Dental Surgery.
		6.15	MR. D. G. WALKER—Infections of the Jaws.

* Owing to the increase in costs it has become necessary to increase the price of the Monthly Dinner to 25s. (including drinks) with effect from January, 1948.

Note.—All the above lectures form part of courses.

Thur.	15	5.00	Mr. V. H. Ellis—Pyogenic Affections of Hip and Knee Joints.
		5.00	Prof. H. A. Harris—Bone Growth.
		6.15	Dr. E. A. Pask—Physiology of Anæsthesia.
Fri.	16	5.00	Mr. A. Rocyn Jones—Congenital Dislocation of the Hip.
		5.00	Dr. J. Short—Development of the Face.
		6.15	Dr. G. N. Jenkins—Saliva.
Mon.	19	5.00	Mr. F. W. Holdsworth—Fractures Involving the Knee Joint.
		5.00	Prof. S. L. Baker—Reactions of Bone to Injury.
		6.15	Prof. H. F. Humphreys—Tooth Form and Function.
Tues.	20	5.00	Mr. E. P. Brockman—Congenital Deformities of the Foot.
		5.00	Dr. J. Whillis—Deglutition.
		6.15	Dr. W. V. Thorpe—Endocrine.
Wed.	21		Primary F.R.C.S. Examination begins.
		5.00	Mr. R. Broomhead—Muscle and Tendon Ruptures.
		5.00	Mr. G. Heaton—Fluorosis.
		6.15	Prof. F. Goldby—Trigeminal Nerve.
Thur.	22	5.00	Mr. P. Wiles—Postural Deformities of the Spine.
		5.00	
		6.15	Mr. A. Bulleid—Oral Bacteriology.
Fri.	23		Final L.D.S. Examination begins.
		5.00	Mr. A. J. Watson—Ankle Joint Fractures.
		5.00	Prof. F. C. Wilkinson—Focal Infection.
Mon.	26	5.00	Mr. H. J. Burrows—Static Derangements of the Foot.
		5.00	Prof. J. F. D. Shrewsbury—The Modes of Transmission of Bacterial Diseases, with special reference to the Transmission of Oral Infections (Part I.)
		6.15	Mr. E. B. Manley—The Structure of Human Enamel.
Tues.	27	5.00	Mr. R. Barnes—Brachial Flexus Injuries.
		5.00	Prof. J. F. D. Shrewsbury—The Modes of Transmission of Bacterial Diseases (Part II).
		6.15	Mr. E. B. Manley—Dentine and Pulp and their Functions.
Wed.	28	5.00	Mr. R. B. Young—Derangements of Lumbar Spine and Pelvic Joints.
		5.00	Prof. W. T. Astbury—Collagen and Keratin.
		6.15	Mr. E. B. Manley—The Role of the Epithelin in Tooth Development.
Thur.	29	5.00	Mr. St. J. D. Buxton—Fractures and Dislocation of the Shoulder Joint.
		5.00	Prof. R. V. Bradlaw—Tumours of the Jaws.
Fri.	30	5.00	Mr. G. B. Pritchard—Pathology of Pulp.

Note.—All the above lectures form part of courses.

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